The Dock & Harbour Authority

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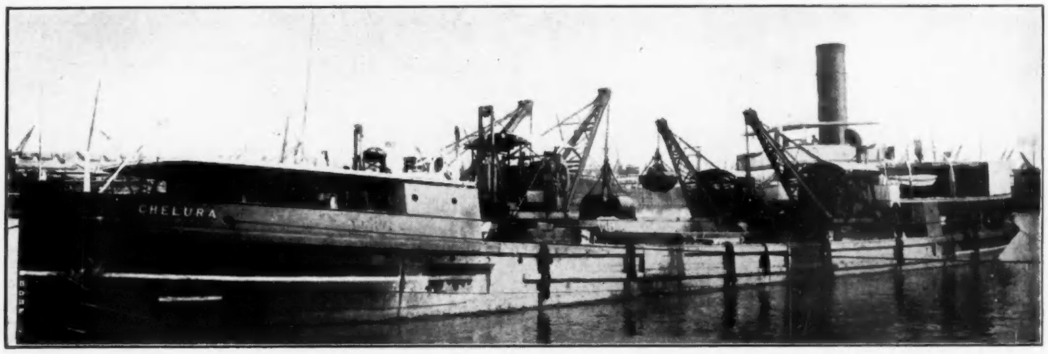
34-year-old "Priestman" is still the largest Grab-hopper Dredger in service

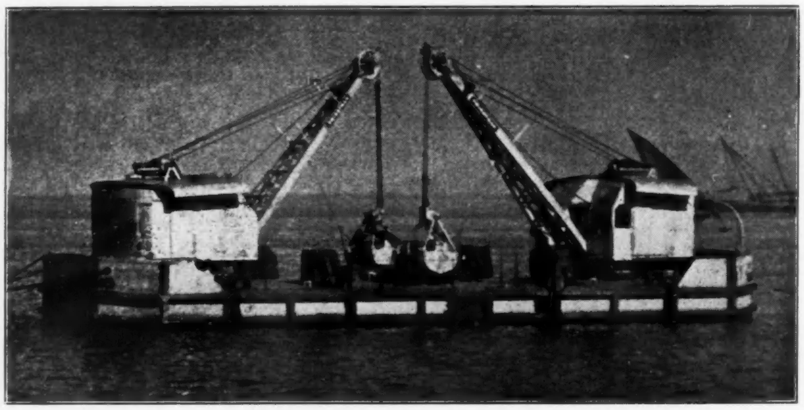
Bombay Port Trust specify "Priestman" on new Dredger



Thirty-four years may not, by comparison with the records of some venerable dredgers, be an exceptional life-span, but it is unusual in these days for the "world's largest" of anything to remain so for so long a period.

This is the record of the grab - hopper dredger "Chelura," fitted with four Priestman 3 - yard capacity grab dredging cranes, and owned by the Bombay Port Trust. After thirty-four years of monsoons, tropical heat, and all the difficulties which normally attend these conditions; the "Chelura" is not only still the "world's largest," but is every bit as efficient as she was in 1922.

After such a demonstration of reliability, it is hardly to be wondered that Priestman dredging cranes were specified when the Port Trust decided to purchase a further grab dredger.



The pontoon type dredger "Mayur" was built by The Mazagon Dock Ltd. at Bombay and has dimensions as follows:

Length	75-ft. 0-in.
Breadth	30-ft. 0-in.
Depth	8-ft. 0-in.
Draft	4-ft. 9-in.

It is arranged with a Priestman 2 cu. yd. dredging crane at each end with the necessary fuel and water tanks below decks amidships. Four winches for manoeuvring purposes are placed on deck amidships. In order to avoid damage to or from barges laid alongside the vessel is fitted with heavy fenders at deck and water level.

The two Diesel driven dredging cranes are of the Priestman No. 40 size, each arranged to operate with a total load of grab and contents of 4.4 tons at a maximum radius of 28-ft. from a jib of 31-ft. centres. The ropes are sufficiently long to allow the 2 cu. yd. grabs to be operated at a depth of 60-ft. below deck level.

The crane mechanism consists of separate power-operated drums on independent shafts and incorporates all those special Priestman features developed by their makers which have contributed so much to the successful operation of grab dredging equipment.

The Diesel engines develop 75 brake horse-power at 1200 revolutions per minute and are fitted with fluid couplings together with special oil coolers.

The mechanism and driver's platform are covered with a well-built steel house with large opening windows and shutters and a double roof with wide overhanging eaves. The driver thus has the maximum amount of protection from the elements and is not expected to sit in a partly exposed position under a sunshade roof.

The elimination of fatigue by well-designed controls and the provision of a comfortable driving seat leads to greater output per man-hour.

The dredger is for use in the docks at Bombay, where the spoil will be discharged into barges alongside and then towed out to be dumped in open water.

THE PRIESTMAN SYSTEM

ECONOMICAL · ACCURATE

PRIESTMAN BROTHERS LTD. HULL, ENGLAND

The Dock & Harbour Authority

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Editorial Comments

The Port of Cardiff.

During the next few months, this Journal is publishing a series of articles dealing with the ports of South Wales, and we are indebted to Mr. W. Jeffers, Chief Docks Manager, South Wales Docks for the article on a following page which gives a history of the Port of Cardiff.

Following the nationalisation of the railways in 1948, the South Wales Docks, comprising Cardiff and Penarth, Swansea, Newport and Lydney, Barry and Port Talbot came under the control of the British Transport Commission and a Docks Management Board is responsible for the overall management of the ports and for any future developments which may be contemplated.

It is an unfortunate fact that, owing to the recession of trade and more particularly of coal exports during recent years, the prosperity of Cardiff and her sister ports, has seriously declined. Despite the continuing expansion of United Kingdom trade, the total traffic handled at the South Wales Docks in 1956 was over 1,500,000 tons less than in 1955 and the figures for the first four months of this year show a still further decrease.

Many proposals have been put forward with a view to finding a remedy, but in view of the changes in the pattern of trade during recent years, it seems that only drastic methods are likely to be effective. Where Cardiff is concerned, an interesting suggestion has been propounded by Sir Herbert Merrett, who published an outline of his plan in a recent issue of the "P.D. Review"—the Journal of Powell Duffryn Ltd. group of companies. Explaining his scheme, Sir Herbert points out that the West Dock was built to accommodate fleets of small vessels, for the most part sail, engaged in the transport of coal. This trade has become practically extinct and the small movement of traffic which still remains could be transferred elsewhere. The East Dock is obsolete for somewhat similar reasons. However, the space these docks occupy, with the high levels which lie between them, offers a potential site of between 150 and 200 acres for new industries. Sir Herbert suggests, therefore, that these two docks should be filled in by utilising the material from the high levels, which were formed when they were cut.

Sir Herbert also emphasises the importance of improving the facilities of the Queen's and Roath Docks and Basin, and suggests that a new and deeper entrance should be provided to the Queen's Dock as, in his view, it would not be economical to attempt to enlarge the existing entrance as the deepening of the sill would also entail deepening the whole lock. The present entrance makes the entry of ships a difficult manœuvre and it is suggested that a new entrance should be constructed on the north side of the locks where it was once intended to build a dry dock.

There is no doubt that such extensive engineering works would prove very costly but, under present circumstances, the prospects of trade expansion by ordinary means are remote. If, however, new industries could be attracted to the area, the potential increase in the trade of the port would be considerable.

The Suez Canal.

Elsewhere in this issue will be found an official, authoritative account of improvements and developments which had been planned and carried out in part by the Suez Canal Company up to the "nationalisation" of the company last July. It may be thought by some that in view of all that has happened since then, the publication of this planning is of little more than academic value, but we think it important that our readers in all parts of the world should have placed before them an objective appraisal of the work of the Suez Canal Company and a sober statement of the way in which the company regarded its responsibilities. The experience of many years, as the annual report of the Chamber of Shipping expressed it, had led shipowners to rely on the Company for the highest standards in the fulfilment of the obligations placed upon it—namely, freedom of transit for vessels of all flags without any discrimination; efficient management, maintenance and development of the canal; and reasonable dues. Shipowners consulted with the company not only on the level of dues, but on a much wider basis—the development of the Canal to meet the unprecedented increase in traffic anticipated in the coming years. This envisaged the Canal being developed to cater for all the demands likely to be made on it, not only up to 1968 when the concession to the company was due to expire, but well beyond.

The statement now published will show how the company's improvement programmes were envisaged, and what they entailed. It is disquieting to be reminded that as a result of Nasser's action in 1956 the tenders in connection with the 8th programme were left in abeyance and that the effect of the events which followed was to slow down and then to stop the works completely. And what of the 9th programme? It will be seen, as the account points out, that works of great magnitude are involved, but it would have been possible to carry them out in good time, in spite of the approaching expiry of the company's concession. The cost, it is estimated, would amount to nearly £100 m., and while the board had not yet had to decide on the implementation of this programme, "it is certain that such a decision, rendered both necessary and possible by the increase in traffic, would have been duly made and carried into effect, in conformity with the company's traditions and its concern for ensuring with the greatest efficiency the important public service for which it is responsible."

By the time these words appear in print the situation may well have been resolved, for every indication at the time of writing pointed to a general resumption of the use of the Canal. The 15 member-States of the Suez Canal Users' Association have reserved all their legal rights under the 1888 convention and otherwise, but obviously did not feel in a position to recommend that the Canal should not be used and, in effect, have left the decision to individual choice. But Nasser's temporary victory may well prove hollow, for there are warning signs for him. The Minister of Transport has pointed out that the Canal is not quite so essential to Britain's economy as was thought before its closure and has emphasised

Editorial Comments—continued

that unless Egypt concedes terms which are acceptable to the Security Council every effort will be made to build bigger tankers, to deepen ports and harbours, and to build new pipelines and thus reduce dependence of the world on the Canal. The eight major international oil companies have been conferring on the Middle East pipeline situation and there are reports that the British Government have in mind a big project for the construction of an oil pipeline from the Persian Gulf to the Mediterranean **via** Iraq and Turkey. Many millions of pounds will be involved, but there will be full support for a policy which will avoid this country ever again being held to ransom where its vital oil supplies are concerned. The light for Nasser is now amber—it may soon be red.

The Oil Port of Stockholm.

The Harbour Board of Stockholm is now completing the first stage of the construction of new tanker discharging facilities at Varta Bay, and although some of the latest super tankers will be unable to use the berths, vessels of up to 32,000 tons deadweight and 37½-ft. in draught can be accommodated. The treatment of the problem of the maximum size of vessel which should be catered for in the design of new tanker berths is discussed in an article on "The Oil Port of Stockholm" by Mr. P. Leimdörfer, and as this same very real problem is now facing many Port and Harbour undertakings throughout the world, we are indebted to Mr. Leimdorfer for his views. In the near future we hope to include further information regarding the proposals of certain Port Authorities on the question of accommodating the largest tankers.

The design of the berths and facilities at the oil port of Stockholm is very modern and the details which are included will, it is hoped, be of interest from the engineering aspect, particularly as the treatment adopted here is probably typical of other up-to-date facilities now being planned or under construction.

The Clean Air Act.

Sponsored by the Institution of Mechanical Engineers with the participation of a number of other British Societies and Institutions, an important conference on the Mechanical Engineers' Contribution to Clean Air was held in London from 19th—21st February last. Nearly 500 people attended, including a number of delegates from overseas; 20 papers were presented and there were some 52 contributions to the discussions at the technical sessions.

The papers covered a wide range of subjects connected with air pollution, and elsewhere in this issue will be found extracts from a paper, and the ensuing discussion, dealing with the problem of smoke emitted by ships in port.

Giving a summary of the conference, Dr. G. E. Foxwell, C.B.E., pointed out that the Clean Air Act imposed a general obligation on industry to prevent the emission of smoke, dust and grit into the atmosphere, and smoke from ships in port seemed likely to prove a most difficult part of the enforcement of air pollution prevention because a section of the Act allowed the defence that the emission of dark smoke "was solely due to the lighting up of a furnace which was cold." The paper by Messrs. Atkinson and Baker, referred to above, leaves little doubt that, in their view, the nuisance can be abated if the will to abate it is there.

Topical Notes

Ship to Shore Radio Telephone.

Early this month the Post Office inaugurated the first British Station of its new network for marine VHF/FM Telephony. The first station will cover the Firth of Clyde and the Sound of Bute and will enable vessels fitted with appropriate equipment to be linked over a distance of about 40 miles with the public telephone system and provide a clear connection to any subscriber in the United Kingdom. It will also be a useful facility for ships undergoing their trials in the Clyde. Further marine telephony services will be worked through existing coast radio stations at Land's End, Niton (Isle of Wight), North Foreland and Humber (Mablethorpe) as soon as the necessary equipment has been installed.

The main use of the new marine telephony system will be for navigational purposes and for ships' business, but it is likely to prove increasingly valuable to passengers.

This new system, conforming to the recently recommended international standards, is an important development in marine communications, providing highly efficient telephone facilities, free from static and other interference. It is already in operation in the U.S.A. and Canada, on the Great Lakes and the Eastern Seaboard, and has recently been introduced in Scandinavia and elsewhere in Europe. Its adoption by the British Post Office indicates a further advance towards a world-wide system of marine VHF/FM communication.

Dredging Approaches to Hamburg.

It is reported that the Federal German Government will grant nine million marks towards the cost of deepening the River Elbe, so that larger vessels can use the port of Hamburg. A memorandum recently compiled by the Hamburg Senate points out that cargo vessels of 20,000 to 25,000 tons d.w. are already using the port and that 46,000-ton tankers drawing 12 metres of water will be visiting Hamburg within the next two years.

Referring to the many vessels of over 40,000 tons now under construction, the memorandum stresses the importance of the approaches to Hamburg being deepened to enable the port to remain competitive. The first objective must be to increase the depth from 10 to 12 metres at low water, which is estimated to cost 81 million marks. Of this, 21 million marks will fall upon Hamburg for the area in and near the harbour. Here, about 4,200,000 cubic metres of sand will have to be dredged, while a further 20 million cubic metres will have to be dredged from the channel between the harbour and the "Elbe II" light-vessel. An eventual deepening to 13 metres is contemplated.

The memorandum also discusses the possibility of an oil pipeline between Cuxhaven and Hamburg, and adds that calculations show that this would be uneconomic. Apart from the fact that a deeper channel to Hamburg would be required for the large cargo vessels carrying coal and ore, a pipeline, it states, would cost more than the dredging of the river.

Developments at the Port of Amsterdam.

It was recently stated in the press that a new site has been developed in the western part of Amsterdam's harbour, where, since last summer, an increasing number of ships have discharged cargoes of ore and coal. Attention has also been paid to providing facilities for general cargo and in the Coen harbour basin a new general cargo establishment comprising two sheds, with 80,000 sq. ft. of floorspace, has been built at a cost of £600,000. It has also been decided to convert the former log basin, which borders the Coen harbour on the south side, to a general cargo basin. This basin was constructed prior to the Second World War and when converted it will add 4,600 yards to the total length of quay at Amsterdam. The new quay will be equipped with 20 cargo sheds, having a total floor space of about 1,070,000 sq. ft.

Prior to the construction of the road and rail tunnels under the North Sea Canal, which are planned to be ready by 1959, some 6,500-ft. of quay is to be constructed. Work is to commence on the building of 2,700-ft. of quay-wall, the construction of crane-rails and the dredging of the waterway leading to this basin. The cost of this work is estimated at £1m. The depth along the quay, at the outset, is to be 34-ft. below New Amsterdam level. Further dredging of this basin to a depth of 42-ft. is contemplated.

Mexican Port Improvements.

The Secretary of the Mexican Navy has stated that improvement and modernisation work on three Mexican ports will be completed in September. Work has been speeded up at the Pacific coast port of Salina Cruz and the Gulf ports of Tampico and Coatzacoalcos with the aim of completing the work by the end of September.

The Secretary also said that the present development programme, which includes the construction of docks and warehouses and the dredging of several ports on both Mexican coasts, is due to be finished before the end of the present administration in 1958.

The Ports of South Wales

The History and Development of Cardiff

(Specially Contributed)

SITUATED at the mouths of the Rivers Taff and Ely, and protected from the prevailing winds by the jutting foreland of Penarth Head, Cardiff has been a haven for shipping ever since the Middle Ages. Its history may be divided roughly into three main periods; the river period, the canal period and the docks period.

The River Period.

The first recognised berth for the loading and unloading of ships was a quay, said to have been constructed in 1263, situated at the junction of the River Taff and the Tanyard Brook. There were also private wharves below the Town Quay. By the sixteenth century, Cardiff was operating a brisk coastwise trade, mainly with Bristol, Bridgwater and other ports in the vicinity, and also foreign trade with the French Ports of Rochelle and Bordeaux. By the eighteenth century ships from Cardiff were sailing to ports all over the Continent and also to Ireland.

The Canal Period.

At the beginning of the nineteenth century, Cardiff began to experience the growth of the iron trade and the acute need for better transport facilities was felt. In 1784 a Bill was introduced into Parliament for the construction of a canal to link up the Taff and Cynon Valleys with Cardiff. After certain setbacks, the completed canal, including the extension from Abercynon to Aberdare was opened to traffic in 1811. Parliament also sanctioned the extension of the canal to the sea and further authorised the construction of a sea lock. This Glamorganshire Canal, like all the canals constructed in England at that time, was designed to carry barges of a maximum capacity of 20 tons, but it possessed one important feature at the sea end of the canal, a sea lock pond. This lock, 103-ft. long by 27-ft. wide, was the first to be constructed in South Wales. The Canal itself extended upwards of 25 miles, having on its course 50 locks, and the Canal head at Merthyr was 568-ft. above the sea lock at Cardiff.

The extension of the Canal to the sea gave the port of Cardiff its first impetus, as a greatly improved means of transit for iron and coal from the valleys to the sea. The original barges brought down a load of 20 tons, a quantity which had formerly required the efforts of at least forty horses. This resulted in a considerable reduction in the cost of conveying coal and iron, which in turn advantageously affected the amount of export tonnage to be handled by the port.

The land on either side of the sea lock pond was let as wharves or coal yards and by the year 1839 there were operating 11 coal yards, 1 bark yard, 13 wharves, 2 dry docks, 3 warehouses and 2 lumber yards.

Although the Canal was an enormous advantage to the trade of the Port, by this time its disadvantages and limitations were realised. For three hours each tide its entrance was dry, for 58 days of the year there was not sufficient water to enable vessels exceeding 100 tons to enter, and the sea lock was two miles from low water mark, approached by a narrow and tortuous channel. Only vessels up to 200 tons register could enter the gates of the sea lock pond, and vessels of greater tonnage had to load from barges while lying outside in the Roads.

Two coal staiths were erected on the bank of the River Taff, where the course of the river came close to the basin on the east side, to which small coasters could approach during high tide for loading.

By 1885 the Glamorganshire Canal was becoming moribund, except for the Sea Lock Pond, which was enlarged and deepened in an effort to improve the situation, but trade continued to decline. About this time, it became apparent that the amount of water supplied from the River Taff to the Bute Docks (referred to later) was inadequate during times of drought. Arrangements were therefore made with the Canal Company with the object of conserving the considerable amount of water, which was being locked down from the upper reaches, by turning the surplus water into the Docks. From 1880 onwards, only a small quantity of domestic coal came down the Canal, the principal traffic being Patent Fuel from the Maindy Works, but when these closed down in 1928 the remaining traffics were very small. By 1941, most of the Canal had been filled in.

The Docks Period.

It is worthy of note that the first dock in Cardiff was built by the second Marquess of Bute entirely at his own expense, and in the face of lack of experience and many obstacles. At this time, enclosed basins had been built at London, Liverpool, Bristol, Hull and Grimsby by corporate bodies or companies, but the Bute West Dock, as it is now known, was the first enterprise of its kind ever to be undertaken at the sole expense and risk of one man.

After six years of deliberations, the Cardiff side of the River Taff was finally selected as the site of the new dock, and the work of construction commenced in 1837. Prior to the dock itself being started, a channel, or feeder, had to be cut from a point in the River Taff, some two miles above the mouth of the river, to supply the dock with water.

It was necessary to construct locks to cater for the heavy rise and fall of tides, in Cardiff the difference being some 40-ft. The dock was completed in 1839 and opened for traffic in October of that year. The dimensions of the dock and basin, which have remained unaltered, were as follows:

Length of Dock	4,000-ft.
Width of Dock	200-ft.
Length of Basin	300-ft.
Width of Basin	200-ft.
Width of Sea Lock	45-ft.
Area of Dock	19 acres
Area of Basin	1½ acres
Average depth on outer cill, H.W.O.S.T.	27¾-ft.
Average depth on outer cill, H.W.O.N.T.	17¾-ft.

The Taff Vale Railway opened in 1841, and an agreement was made that it should serve the West Dock and also supply and operate coal shipping appliances. The first tips were erected on the west side of the dock, but later were transferred to the east side, leaving the west side to be devoted to handling the import trade, and warehouses were erected.

Trade increased year by year, and by 1851 traffic had become greater than the dock could deal with. It was therefore decided to construct a new dock to the eastward of the existing one. Work commenced in January, 1852, but the ever-increasing trade made it necessary for plans to be altered and even before the first section was completed it was decided to extend the dock by 2,000 feet. The first part of the Bute East Dock was opened in July, 1855 and the first extension in January, 1858, before which it was again decided to extend by a further 1,400 feet. At this time the dock was the largest in Britain, and perhaps in the world. The final dimensions, which have remained unaltered, were as follows:

Total length of Dock	4,300-ft.
Width of Dock	300-ft. for 1,000-ft. 500-ft. for 3,300-ft.
Length of Basin	380-ft.
Width of Basin	250-ft.
Length of Sea Lock	220-ft.
Width of Sea Lock	54¼-ft.
Area of Dock and Basin	46½ acres
Average depth on outer cill, H.W.O.S.T. ...	31¼-ft.
Average depth on outer cill, H.W.O.N.T. ...	21¼-ft.

The dock was provided with facilities for the shipment of coal and the handling of general cargo.

The Ports of South Wales—continued

The Roath Basin.

The annual shipments of coal and coke at Cardiff rose to over two million tons and the total imports and exports to over three million tons, which meant that even the new extended accommodation was rapidly becoming inadequate. The Bute Trustees, therefore, in 1864, again sought Parliamentary powers to provide additional docks and works, but two schemes they proposed were quashed. In 1866, a further application was made to Parliament for powers to construct a dock with a sea basin with access to the entrance channel, with the improvement of that channel and the seaward course of the River Taff. There was also to be a junction lock between this sea basin and the East Dock, a graving dock with an entrance from the new basin, and a low water pier. A road and railway would connect the proposed works with the main town and railway. Sanction of Parliament was obtained for the whole of the work excepting the dock.

The low water pier was constructed and completed in 1868; it was 1,400-ft. long and 34-ft. wide, provided with a railway and carriageway. The pier was equipped with a floating pontoon, a vertical hydraulic lift and a 10-ton hydraulic crane. It was destroyed by fire in 1919 and has never been rebuilt.

The Roath Basin was opened for traffic in 1874, the dimensions being as follows:

Area ...	13 acres
Length ...	1,000-ft.
Width ...	550-ft.
Length of Entrance Lock ...	350-ft.
Width of Entrance Lock ...	80-ft.
Length of Junction Lock with East Dock ...	350-ft.
Width of Junction Lock with East Dock ...	60-ft.

The Commercial Dry Dock, 600-ft. long with an entrance 60-ft. wide, was opened in 1875.

The Roath Dock.

In 1874, powers were sought and granted for the building of a new dock to be connected with the Roath Basin by a lock, but owing to a dispute regarding the free haulage of coal from the main line to the coaling tips, the scheme was not undertaken. An agreement was ultimately reached in 1881 between the then Lord Bute and the Rhymney, Taff Vale and Great Western Railways, that the railways should bring coal down to the tip roads, and work commenced in 1883.

The dock was opened in 1887, the dimensions, which obtain today, being as follows:

Length of Dock ...	2,400-ft.
Width of Dock ...	600-ft.
Length of Lock to Basin ...	600-ft.
Width of Lock to Basin ...	80-ft.
Area of Dock ...	33 acres
Average depth of water ...	34-ft.

The lock, when constructed, was said to be the largest in the world, and was originally fitted with three pairs of gates. When these required renewal in 1932, however, the middle pair were not replaced.

The north side and east end of the dock were laid out for the accommodation of the import trade and were equipped with suitable cranes. At the east end of the dock, a masonry jetty was constructed, extending for a length of 800-ft. into the dock, with a width of 60-ft. This jetty was also equipped with cranes, and a double floor warehouse was constructed on the water end, part of which was set aside exclusively for perishable cargoes requiring cold storage. The south side of the dock was reserved for shipping coal, and near the lock an extensive cattle lairage was provided, including chill rooms, etc., as well as three warehouses. Early in 1888 electric lighting was introduced.

Queen Alexandra Dock.

The Bute Docks Undertaking was transferred to the Bute Docks Company under the terms of the Bute Docks (Transfer) Act of 1886, which incorporated the Company, and in face of the ever-increasing trade of the South Wales Coalfield, and also fearing competition from increasing dock facilities at Barry, the Bute Docks Company in 1894 promoted further Bills before Parliament to construct yet another dock on the foreshore side of the existing constructions. Considerable difficulties were experienced in raising the necessary capital, particularly in view of the heavy estimated cost, the whole site having to be reclaimed from the sea. By 1898, the site had been reclaimed by the construction of an embankment 7,700-ft. in length, and the lock and dock works were then commenced. (The Cardiff Railway Act of 1897 changed the name of the Bute Docks Company to the Cardiff Railway Company, and the docks remained the property of this Company until the passing of the Railways Act of 1921, when they became part of the Great Western Railway.)

The principal dimensions of the Queen Alexandra Dock are as follows:

Length of Dock ...	2,550-ft.
Width of Dock ...	800-ft.
Area of Dock ...	52 acres
Length of Entrance Lock ...	850-ft.
Width of Entrance Lock ...	90-ft.
Average depth on outer cill, H.W.O.S.T. ...	39½-ft.
Average depth on outer cill, H.W.O.N.T. ...	29¾-ft.

A communication passage into the Roath Dock was provided, 590-ft. in length and 90-ft. wide, and a caisson was constructed of steel to fit both the caisson cills of the communication passage and the entrance lock, to be used in any of these positions as necessity required.

A double-track swingbridge was built over the communication passage between the Roath and Queen Alexandra Docks, and another was placed over the entrance lock for a single line railway.

The dock was opened and named "Queen Alexandra Dock" by King Edward VII in July, 1907.

General view, Queen Alexandra Dock.

The Steam Packet Harbour.

When the Marquess of Bute was about to construct the West Dock in the 1830's, he excavated the Steam Packet Harbour, although why it was done at that particular time is not known, except that the flowing of a stream into the sea had scoured a small natural basin at this point. About the year 1860, the first passenger pontoon was placed in position; this is now the northernmost, or No. 1 Pontoon. In 1900 the pontoon which had been provided at the low water pier, was transferred to alongside the first, and became No. 2 Pontoon. The harbour was at that time equipped with a 4-ton and a 5-ton crane, and also a cargo warehouse, but for many years now it has been used almost exclusively by a firm operating a pleasure steamer fleet in the Bristol Channel.

The Port of Cardiff in the 20th Century.

From the opening of the West Dock in 1839, practically every year showed progress in the trade of the port and each decade provided record figures. This state of affairs continued up to the peak year of 1913, when the total trade figure was 13,676,941 tons. In this year, Cardiff was the third most important port in the United Kingdom for the importation of frozen meat, only London and Liverpool importing greater quantities. Then came the first World War, during which it may be said that generally the normal traffics of the port were maintained, though the tonnage declined.


PORT OF CARDIFF
Scale of Feet
Feet 100 0 500 1000 2000 Feet
From Swansea
WOOD STREET
ADAM STREET
GOODS DEPOT
TIMBER YARDS
TYNDALL STREET
TIMBER POND
GLAMORGANSHIRE CANAL
RIVER TAFF
BUTE WEST DOCK
19 Acres
BUTE EAST DOCK
44 Acres
Atlantic Wharf
General Cargo Quay
Coal Hoists
GUEST KEEN BALDWINS IRON & STEEL COY LTD
GUEST KEEN NETTLEFOLDS
COAL SIDINGS
ROATH BASIN
13 Acres
ROATH DOCK
33 Acres
General Cargo Quay
Iron Ore Quay
Grain Conveyor
Coal Conveyors
N SHED
LOCK
PASSAGE
Empire Wharf
Kings Wharf
PIT PROP STORAGE AREA
BEACH SIDINGS
ENTRANCE CHANNEL
Buoy
A. SHED
B. SHED
C. SHED
General Cargo Quay
QUEEN ALEXANDRA DOCK
52 Acres
Movable Coal Hoists
OIL DEPOT
Penarth Flats
Cardiff Flats
BRISTOL CHANNEL
PENARTH BASIN
Fairway Buoy
Inner Wrach Light Buoy
Cefn-y-wrach

The Ports of South Wales—continued

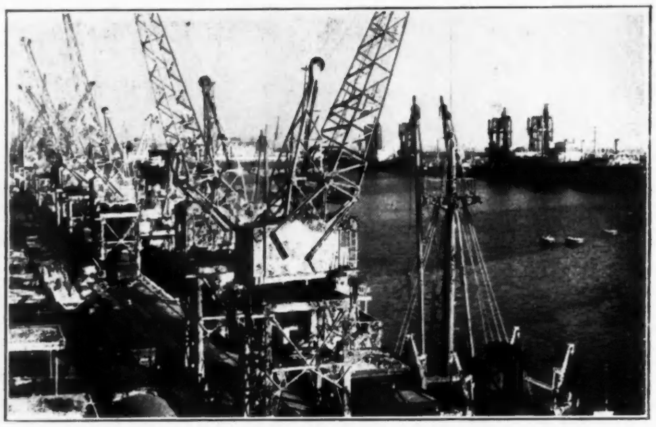
To deal with any emergency which might arise, the Ministry of Shipping erected "A," "B" and "C" Warehouses alongside the Queen Alexandra Dock, and after the war these were purchased by the Dock Authority.

The national coal strikes of 1920 and 1921, which necessitated an embargo on exports, brought the coal and coke export figure down to a level unknown at Cardiff since 1876.

On the 1st January, 1922 under the provisions of the Railways Act, 1921, the railways of Great Britain were amalgamated into four groups, and Cardiff Docks came under the control of the Great Western Railway Company. Under this new management, the import and export figures rose again, so that the total trade figures for 1923 were the best since 1915.

During their twenty-six years of ownership (1922-1947), the Great Western Railway Company carried out extensive programmes of improvement and development.

Coal shipping appliances were altered and reconstructed to cater for 20-ton wagons, and new fixed and movable coal hoists and belt conveyors were provided. Cranes of 2-ton and 3-ton capacity, fixed and movable, a 15-ton electric crane and a 125-ton floating crane, were purchased (the latter being available for use at all the South Wales Docks), as well as a floating grain elevator capable of handling 120 tons of grain per hour. Hydraulic capstans were provided to facilitate the handling of general cargo; electric lighting was installed in all the docks and warehouses, and electrically-driven pumps and other improvements made in the three principal power stations.



View of the General Cargo Quay and coal hoists at the Queen Alexandra Dock, Cardiff.

New centralised workshops for the mechanical engineers' department were built, as well as new stores, and the cattle lairs were extended and improved. New storage sidings and other railway lines were laid down, and roadways improved and extended. A new tug, now known as the "Baron Glanely," was purchased, and the entrance to the commercial dry dock was widened at cill level.

During the Second World War, there were further improvements to Cardiff Docks. The Ministry of Food erected a cold store on the King's Wharf, Queen Alexandra Dock, which was, and still is, managed by the Dock Authority. Two berths were re-modelled and a new shed erected. Heavy lift floating cranes were provided, two of which were designed by members of the Docks staff. Many new quayside cranes were supplied, and the most up-to-date appliances obtained for handling the varied cargoes which came to Cardiff as a result of the Government's "east-to-west coast diversion" policy.

In the year 1948, upon the nationalisation of the British Railways, Cardiff, in common with the other South Wales Ports, became vested in public ownership. The South Wales Docks are now managed as an integrated group, under the Docks Management Board of the British Transport Commission. Under this overall management, further development and modernisation plans have been carried out.

The pumping equipment for the Commercial Dry Dock, which had been installed over fifty years ago and given very good service, was scheduled for replacement before the Second World War. The commencement of hostilities meant the postponement of this replacement, and by the end of the war very considerable difficulty was being experienced in keeping the Pumping Station operable, mainly because of deterioration in the water tube boilers. Taking all matters into consideration, it was decided that it would be most efficient for the new equipment to be electrically operated, and the old machinery was removed by the Mechanical and Electrical Engineering Department, who also did all the preparatory work for the installation of the new pumps and electrical equipment.

Both the Mechanical and Electrical Engineer's Department and the Civil Engineer's Department have been concerned in the major scheme for the electrification of the No. 1 Power Station, Queen Alexandra Dock, which necessitated the installation of new electric impounding, hydraulic and house drainage pumps.

A good deal of reconstruction work has been necessary to railway bridges, swingbridges, etc., as a result of the long war period when no major works could be undertaken, and the Civil Engineer's Department have also renewed the dock gates at the Queen Alexandra Dock Outer Lock. The Roath Sea Inner and Outer Lock Gates have been overhauled and repaired in dry dock. An extensive programme of reconstruction and modernisation of messrooms, lodges and offices has been carried out, as well as maintenance and repairs, and the making good of war damage to buildings, etc. The maintenance and relaying of railway tracks is a regular feature, involving about 170 miles of permanent way, and in addition the Commission is often called upon to undertake major alterations to railway layout due to projects promoted by tenants, etc., on the Dock Estate. Dock roads and crane tracks also fall for a regular maintenance and renewal by the Civil Engineer's Department.

To make good a war loss, a new dredger—"The Taff"—was acquired in 1946. This is a non-propelling bucket dredger, capable of dredging to a depth of 50-ft., with 45 buckets, each of 27 cu. ft. capacity, which can lift 900 tons of spoil per hour. This craft is equipped with special flood lights for night working, and has a 6-ton crane fitted on top of the forward structure. Special attention was given to the design of this vessel, which has proved most efficient and economical, easy to work, and comfortable to live in.

Penarth Dock.

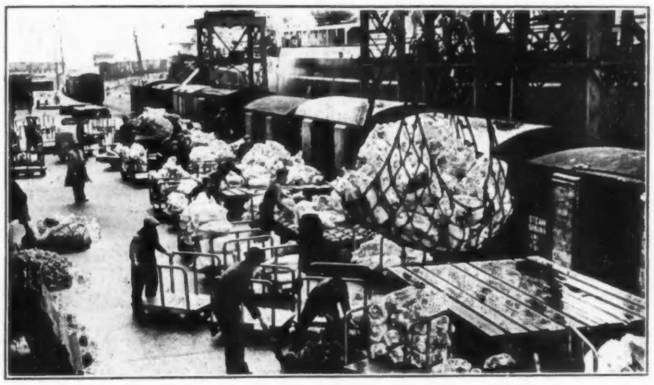
During the time the West Dock was under construction by the Marquess of Bute, and a railway by the Taff Vale Railway Company, the two interests could not agree on the terms of access of the railway to the dock. The Railway Company accordingly proposed to establish a rival dock near the mouth of the River Ely, to be known as the Ely Dock and Tidal Harbour, and connected by a branch line to the main railway. The dock project was abandoned owing to the cost, and the Railway Company compromised by building a few coal staiths on the bank of the River Ely. In 1856, Parliamentary powers were granted to a group of industrialists to convert the lower reach of the Ely river into a tidal harbour, and the Railway agreed to co-operate with them. In the following year, however, a further Act authorised the building of Penarth Dock.

The Ely Harbour and Railway were opened in July, 1859; the facilities provided included coal shipping staiths, ballast cranes and an iron ore wharf. In the same year, work commenced on the Penarth Dock, which was completed in 1865. In 1880 it was decided to extend the Dock, the extension being completed in 1884, and a new entrance was dredged in the 1890's in order that some of the largest cargo steamers could then be accommodated.

In the 1890's, attempts were made to build a further dock at Penarth, to be named the Windsor Dock, but Parliament refused to grant the necessary powers. In 1912 a site was leased by the Railway Company to the Penarth Pontoon, Slipway and Ship Repairing Co. Ltd.

Owing to the steady decrease in the South Wales coal trade, in 1936 Penarth Dock was temporarily closed to all export and import traffic. This situation continues to obtain to-day, although there is complete access to the Penarth Pontoon, Slipway and Ship

The Ports of South Wales—continued



S.S. " Urmston Grange " discharging frozen meat.

Repairing Company's premises, and vessels are also admitted to the dock for lying up for extended periods.

In the Tidal Harbour, there are oil-discharging berths, at which oil is pumped from tankers by pipeline to oil storage depots, and several oil firms have established depots for the storage of motor spirit on the wharves. There are also four coal tips at the Harbour.

Ship Repairing at Cardiff.

One of the most important activities at the port of Cardiff is that of ship repairing, with its ancillary engineering and other allied trades. Unlike most of the important ship-repairing centres of this country, this industry at Cardiff is carried on without a close association with ship building. No ship has been built there since 1889.

The first dry dock was built on the East Canal Wharf in 1829, and twenty years later a dry dock was constructed at the north-west corner of the Bute West Dock, by Messrs. Charles Hill & Sons of Bristol. This is now the Bute West Graving Dock, measuring 235-ft. by 40-ft. In 1858, Messrs. Charles Hill & Sons constructed two further dry docks at the West side of the East Dock. These have been extended and now measure 408-ft. by 49½-ft., and 400-ft. by 45-ft. respectively. They are now owned and operated by Messrs. C. H. Bailey Ltd., who also operate the Junction Dry Dock, measuring 419-ft. by 60-ft. This dry dock was built at the southern end of the East and West Docks in 1879 by Messrs. Parfitt & Jenkins, with caissons at either end, one of which communicates with the East Basin and the other with the West Dock. Fifteen years later the lease was transferred to the Cardiff Junction Dry Dock and Engineering Company Ltd., from whom it was eventually acquired by Messrs. C. H. Bailey Ltd.

The building of the Commercial Dry Dock at the northern end of Roath Basin in 1875 has already been reported. This has remained the property of the Dock Authority and is available for hire. A gridiron, 350-ft. long by 35-ft. wide, was constructed by the Bute Docks Company. It consists of large baulks of timber laid horizontally, upon which lies the keel of the ship, and a wooden staging on the shore side, against which the ship is supported. The vessel takes up its position on a falling tide, and as the water recedes, is left high and dry.

In 1882, the Mount Stuart Shipbuilding Graving Docks and Engineering Company, Ltd., acquired a shipyard to the south of the Packet Harbour, together with a dry dock, and opened a second dry dock there in 1884. Now known as Mountstuart Dry Docks Ltd., the firm's undertaking at this yard now consists of three dry docks of the following dimensions:—

No. 1	Length 430-ft.	Width 52¾-ft.
No. 2	Length 495-ft.	Width 63-ft.
No. 3	Length 543-ft.	Width 66-ft.

Mountstuart Dry Docks Ltd., also own the Bute Dry Dock, built in 1885 by the Bute Shipbuilding, Engineering and Dry Dock Company, and now measuring 600-ft. by 71½-ft., and the Channel Dry Dock, measuring 635-ft. by 75-ft., which was built in 1897 by the Channel Dry Docks and Engineering Company.

The dry docks at Cardiff maintain a high standard of up-to-date efficiency, including the recent introduction of tank-cleaning and gas-freeing plant for the convenience of oil-burning vessels and oil tankers using the Port.

Cold Storage Facilities.

Cardiff has been provided with good cold storage facilities from a very early date. As has been stated, in 1887 a masonry jetty was built at the eastern end of the Roath Dock, extending 800-ft. into the Dock, and at its western end a double-floor warehouse was constructed, part of which was set aside exclusively for perishable cargoes requiring storage. This cold store was demolished prior to the commencement of the building of Messrs. Spillers Mills and Silo in 1932.

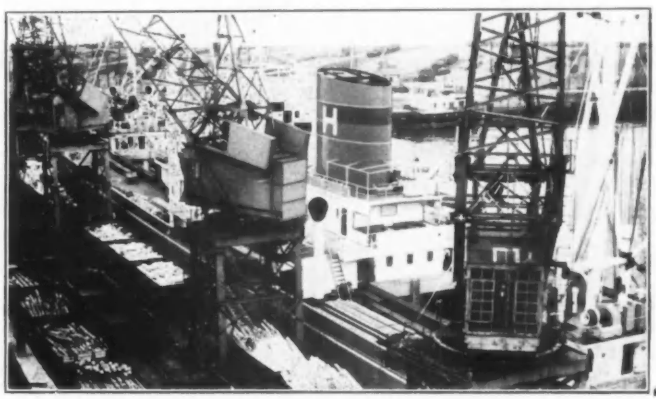
By 1913, Cardiff was the third most important port in the United Kingdom for the importation of frozen meat, being excelled only by London and Liverpool. In 1914 a new cold store was opened at the extreme western end of the north side of Queen Alexandra Dock, with a quayside frontage of 300-ft. This store had one receiving floor and three refrigerated floors, each containing three chambers, with a total storage capacity of 300,000 cu. ft. In 1938 the store was stripped of its refrigerating plant and is now used as a warehouse for general cargoes.

In 1940, the King's Wharf Cold Store, Queen Alexandra Dock, was commenced by the Ministry of Food. This is one of the most modern Cold Stores in the country, and is now controlled by National Cold Stores (Management) Ltd., and is managed by the British Transport Commission. It is a steel-framed brick structure of five floors, comprising 26 chambers in six sections of approximately equal size, equipped with nine 2-ton electric lifts. The total refrigerated space provided is 1,018,612 cu. ft., capable of accommodating about 10,000 tons of goods. The store is built alongside a deepwater berth, and served by excellent rail and road connections for the expeditious receiving and distribution of refrigerated cargoes. In addition to meat, the store handles butter, cheese, eggs, fish and other foodstuffs requiring cold storage accommodation.

Timber.

The importation of timber has always been a feature of the trade of Cardiff Docks, and this may be readily understood in view of the large quantities of pitwood and mining timber regularly required for use in the South Wales coalfields, apart from the requirements of building and wood-working industries in South Wales and the Midlands. Generally speaking, pitwood, mainly from Canada, Newfoundland, Scandinavia, France, Spain, Portugal and Finland, is imported for direct despatch to the various local collieries, but large stocks of pitprops from similar sources are regularly held at the Docks, for which purpose excellent stacking grounds are available.

Other classes of timber, both hard and soft, are dealt with by a



Discharging pitprops and timber from the Bahamas at King's Wharf, Cardiff.

The Ports of South Wales—continued

number of large importing firms who measure, classify, store and subsequently despatch according to specification, the numerous kinds of wood held in stock at their establishments on the Docks Estate. Many different varieties of timber are imported, including deals, battens and boards from Russia, Scandinavia, the Baltic and Canada; logs, baulks and sawn wood from the U.S.A. and Canada; oak from America, Poland and Jugoslavia; and various other woods from Canada, Burma, Central Europe, etc. Good storage ground is available for the imported wood, and water storage is provided for log and baulk timber, the timber pond being connected to the main dock system by canal.

Grain Mills and Silos.

By 1896, Cardiff was the fourth port in the United Kingdom for the importation of grain and flour, and premises were built and equipped at the West and East Docks. However, the increase in size of grain-carrying steamers meant that vessels had to be discharged in the deep water docks and transferred by barge to the grain wharves. A new site was therefore chosen at the Roath Dock, where there was a depth of 33½-ft. of water alongside the 800-ft. jetty.

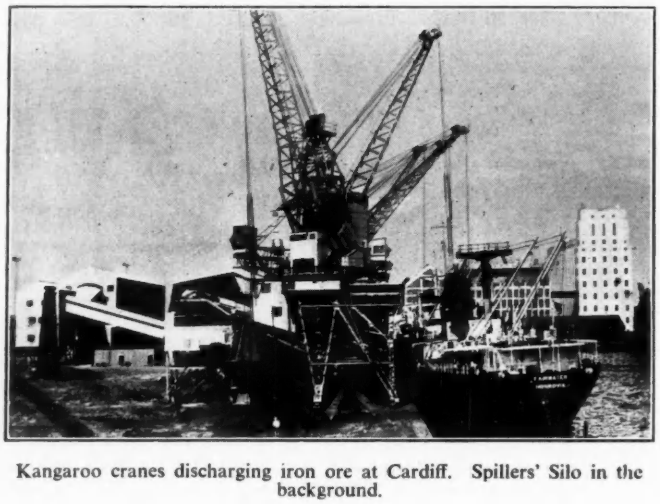
The installation, owned and operated by Messrs. Spillers Ltd., covers an area of 4½ acres. On the south side is a silo, 230-ft. long, 70-ft. wide and 123-ft. high, capable of holding 30,000 tons of grain. On the east side is a Mill with a capacity of 100 sacks of flour per hour, and a biscuit factory. On the west side is an animal food factory and on the north side the warehousing and distributing centre. Two pneumatic intake plants, travelling along rails on the jetty, suck the grain from the ships' holds to band conveyors, by which it is transferred to the silo. The rate of discharge is from 200 to 250 tons per hour.

The Iron and Steel Trade.

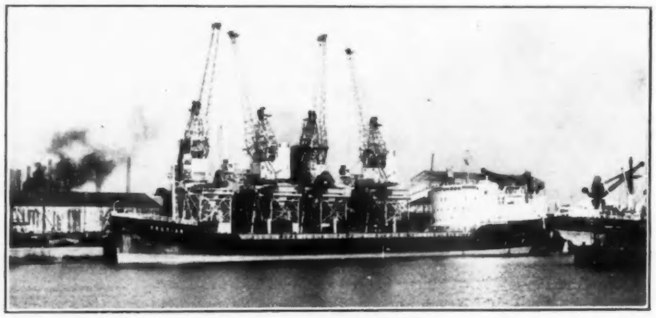
Although it was by the shipment of coal that Cardiff Docks prospered, it was iron smelting that laid the foundation of the industrial life of the hinterland and the development of the port.

The year 1760 saw the commencement of the iron era in the Merthyr district, for in that vicinity ore, limestone and coal, the three principal raw materials required for the manufacture of iron, existed in close proximity. During that and the following decades, a number of ironmasters came from England and set up foundries. In 1769, John Guest acquired the Dowlais Works and was the first to introduce into South Wales the process of using coal instead of charcoal for smelting. During the second half of the eighteenth century the production of iron increased, and by 1796 there were eleven furnaces in full operation in the area.

With the rapid development of railways, the manufacture of iron rails in South Wales boomed, and by 1860 Cardiff had exported 1,534,000 tons. From 1870 onwards, iron was eclipsed by steel and the South Wales ironworks turned to the manufacture of mild steel bars for the tinplate industry; by the end of the century, 50 per cent. of the production in South Wales was used for this purpose.



Kangaroo cranes discharging iron ore at Cardiff. Spillers' Silo in the background.



M.V. " Oredian " discharging iron ore at the Guest Keen Iron and Steel Co. berth.

From 1870, the iron and steel industry in South Wales was built up on supplies of foreign ore, especially Spanish Haematite. In 1891, with the intention of having a dockside location, thus cutting transport costs, the Dowlais Iron Company opened a Works at the docks for the manufacture of steel plates, although still retaining their rail-making plant at Dowlais. These new works were claimed at the time of their opening to be the finest in the world, and with their subsequent extensions, have retained their place in the modern developments of the steel industry in South Wales. Guest Keen Iron & Steel Company, as it is now known, has recently improved their discharging facilities at the Roath Dock by the installation of a battery of " Kangaroo " electric cranes capable of handling a million tons of imported iron ore in a year. The cranes lift the ore from the vessels by means of giant grabs and it is then conveyed to the crushing plant and stockyard of the steelworks by conveyor belts.

In 1901, the Guest Keen Company acquired the nut and bolt firm of Nettlefolds, thus forming the firm of Guest, Keen and Nettlefolds, Ltd., with their works adjacent to the parent firm. To-day the firm receives from Guest Keen Iron & Steel Company the raw materials necessary to feed its five mills, world-famous for their iron and steel products, nuts, bolts, screws, etc. The five Mills comprise a continuous wire rod mill; a continuous steel bar/strip mill; 12-in. by 9-in. steel rolling mills; a cold steel rolling mill, and a steel wire nail-making department.

Dredging.

The Port of Cardiff, situated under the high ground of Penarth Head, is well sheltered from the prevailing westerly winds. Because of its situation in an extensive bight in the Bristol Channel into which flow the waters of three rivers, the Taff, the Ely and the Rhymney, and where silt carried in suspension by the tidal waters of the Bristol Channel tends to settle, a substantial amount of dredging has to be carried out in the approach channels in order to provide depths of water ranging from 39¾-ft. at M.H.W.S.T., to 29¾-ft. at M.H.W.N.T. in the channel leading to Queen Alexandra Dock.

The work, which involves the removal of some 1,500,000 cubic yards of material annually, is carried out by two steam-driven dumb bucket dredgers, served by four steam hopper barges. All these craft are modern in design, and the dredger " Taff " is of post-war construction incorporating many improvements. Because of the considerable range of tide in the Bristol Channel, dredging has to be carried out on a day and night tidal basis, and this involves the crews sleeping aboard, and therefore the provision of suitable accommodation for them.

A recent innovation has been the introduction of V.H.F. radio communication between the dredging craft and their shore-based control points. Even within the environs of the port, the craft are often some distance away from shore and the V.H.F. installation has proved very advantageous.

The Oil Port of Stockholm

Development of a new harbour

By P. LEIMDÖRFER, D.Sc.(Eng.), M.A.S.C.E.
(The Harbour Board of Stockholm)

Introduction.

THE old Oil Port of the City of Stockholm was constructed between 1927 and 1932 and consisted of seven small piers of outmoded timber and steel construction. Owing to the increased oil import after the Second World War, the City authorities decided upon the construction of a new Oil Port with adequate facilities for both reception and storage, located on the site of the old oil piers. Preliminary design was started in 1947 and design studies were made of the latest existing installations in Europe and the U.S.A.

After discussion of several alternative proposals the final design was adopted in 1953 (Fig. 1). It consists of a series of finger piers for large tankers up to 32,000 tons D.W. and two shore-sited oil wharves for berthing laden tankers up to 25,000 tons D.W. The size of vessels to be received and the angle between the pier axis and the new oil wharves were particularly investigated. The construction of Pier No. 1 was started early in the spring of 1954 and the first tanker was berthed in the summer of 1956 (Fig. 2). After the completion of Pier No. 1 the work on Wharf No. I started. This will be finished in 1958 when construction of Wharf No. II will be commenced. As soon as this wharf is completed around 1960, the first stage of the new Oil Port can be considered to be finished. A date for the commencement of work on Piers No. 2 and 3 has not yet been fixed.

A movable screen structure connecting the outer ends of Piers No. 2 and 3 is being considered for the future in order to isolate the polluted water area of the Oil harbour. With the aim of reducing the risk of fire as well as oil pollution in the nearby fairway, special cleansing devices will be developed. Construction of Piers No. 4 and 5 is not contemplated for the time being and their realisation will depend upon the further development of oil imports.

This paper deals with the general layout and the description of the waterfront development, especially of that of the completed Pier No. 1. Determination of the basic dimensions and particulars of the structural nature of this pier as well as some nautical aspects involved will be discussed. Dredging and reclamation, arrangement of facilities, the pier equipment, and the administration and capacity of Pier No. 1 will also be considered. Design details of the oil wharves will be given in another article.

1. GENERAL LAYOUT

It will be seen from Fig. 3 (site plan) that the Oil Port is sited in the Kaknäs area of Värta Bay, which is remote from the densely inhabited quarters of the town.

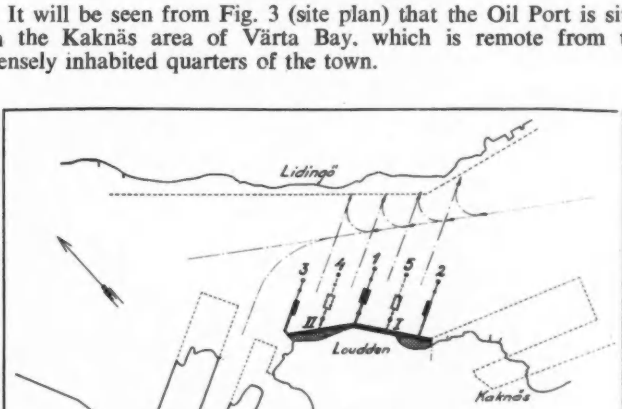


Fig. 1. Oil Harbour at Louddon. Proposed final state.

To satisfy the expected increase in oil import, the first construction stage was to comprise four berthing places for large vessels and a series of berths for coastal tankers. The scarcity of quayage within Stockholm, in general, and the short length of the available shore line in the Oil Port in particular, compelled the Harbour Board to exploit the limited wharf length as much as possible and, additionally, to increase the water frontage by constructing piers.

Having solved the problem of siting, the next step to decide upon was (a) the type of wharf, (b) the type of pier, and (c) the angle between wharves and pier. Five different alternatives were discussed, two of which were concerned with the wharves and three with the jetty.

(a) Type of Wharf.

The ideal solution for the wharf design (shown in Fig. 4a) was a continuous quay according to the old pattern for general cargo wharves. However, estimates confirmed an appreciable saving by adopting the marginal type of wharf (Fig. 4b), which consists of sections of different lengths suitable to the requirements of berthing tankers. Besides, it was anticipated that the single sections

Fig. 2. No. 1 Pier in Use.

could easily be joined later on in the event of experience showing the necessity and of requisite means being at disposal. Therefore, this second alternative was chosen.

(b) Type of Pier.

As regards the pier, the L- and T-shaped systems (Fig. 4d, e) were unsuitable since they needed considerable space for only two vessels and, simultaneously, rather obstructed the passage of other vessels to and from the wharves. The finger jetty (Fig. 4c) was deemed most advantageous and was finally accepted.

(c) Angle of Pier Axis to Shore Line.

Any interruption of a shore line by a protruding construction, e.g. a pier, causes loss of quayage. As has been pointed out, in the present case it was of greatest importance to minimise any shortening of the length of the wharves. Simultaneously, however, the requirements of navigation were to be taken into account.

An analytical method leads to the general formula

$$f = b_0 \frac{0.5K + \cos\frac{\alpha}{2}}{\sin\frac{\alpha}{2}}$$

where f is the wharf length to be sacrificed in case of a projecting

The Oil Port of Stockholm—*continued*

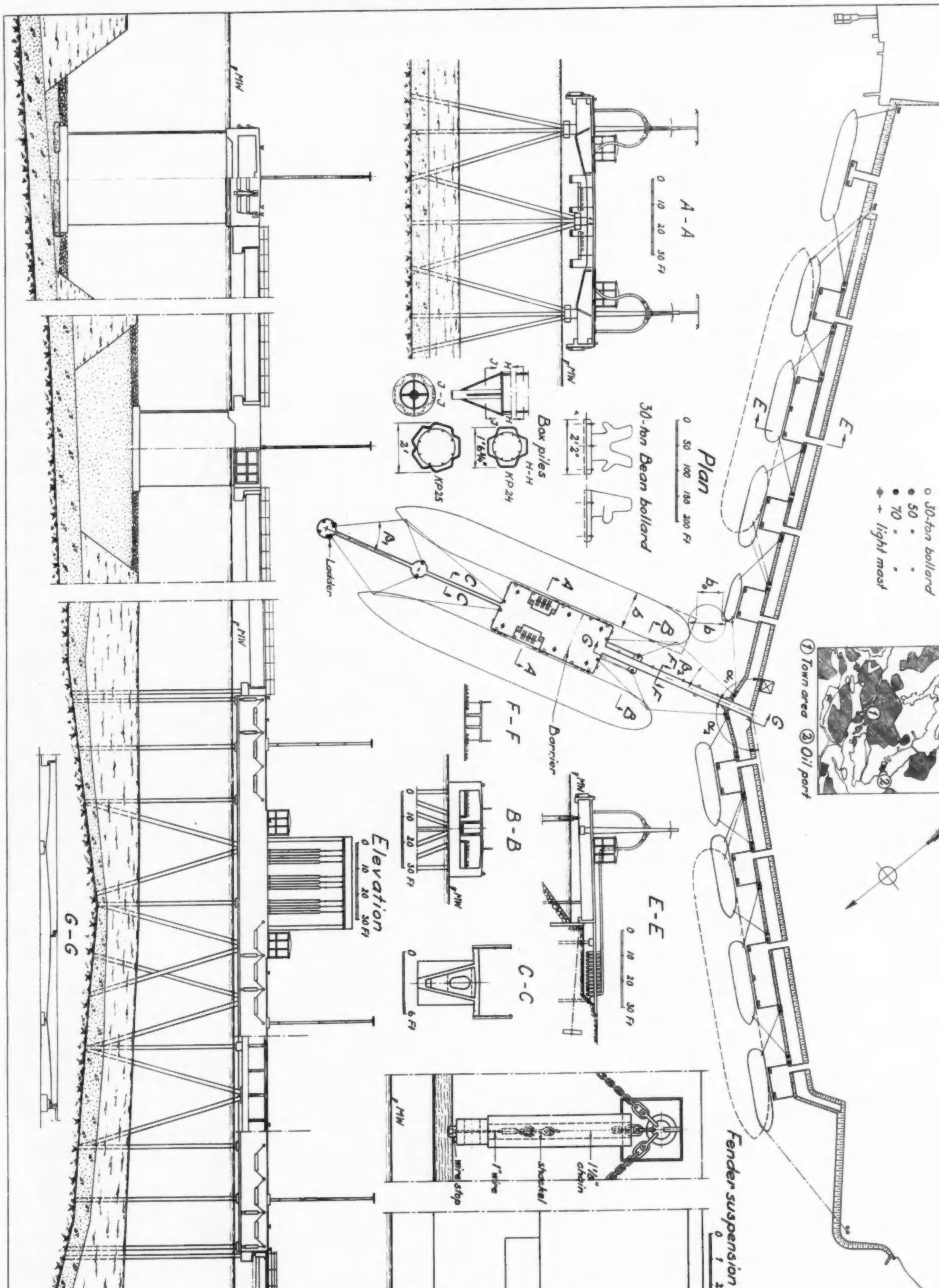


Fig. 3. The Oil Port of Stockholm—Site plan and details.

The Oil Port of Stockholm—*continued*

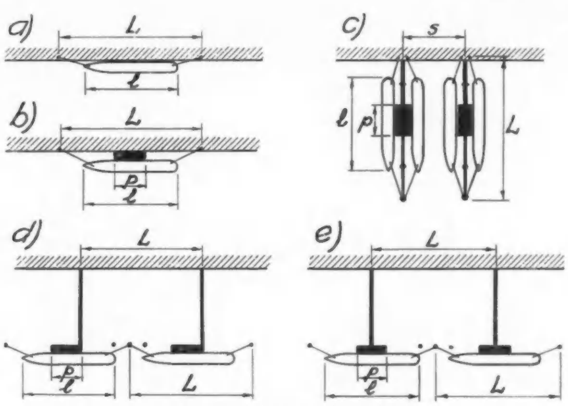


Fig. 4. Wharf types investigated.

pier, α is the variable angle of pier axis to shore line, b_o the distance between the corners of the circumferential parallelograms of vessels concerned (Fig. 3, plan). $K = \frac{b_o}{b}$
where b is assumed to be equal to the ship beam. The computations resulted in choosing $\alpha_1 = 80°$ and $\alpha_2 = 123°$ which decision was considered most favourable also taking into account the prevailing westerly winds. The new piers thus became parallel to the nearby piers of the Free Port.

2. BASIC DIMENSIONS OF PIER No. 1 (Fig. 3)

The pier head is connected with the land by approach trestles carrying a roadway and two adjacent narrow walkways as well as a pipeway beneath. The pipelines are slung beneath the pier head deck in order to afford maximum exploitation of the deck surface. Mooring bollards are sited on two outer dolphins, the pier-head, support No. 3 of the approach trestles, and on the quays. Access to the two mooring dolphins is afforded by means of foot-way trestles.

To obtain the optimum dimensions of the pier it was necessary to start by determining (a) the requisite water depth, (b) the total length of the pier installation and (c) the shape of the pier head.

(a) The Water Depth.

Having regard to the ever increasing D.W. of oil carriers and taking into account the existing water depth in the Värta Bay as well as that of the approach channels, it was initially decided to extend the new oil port installations to cater primarily for vessels of 20,000 tons D.W. Extensive investigations as regards the financial effect of increasing the capacity of Pier No. 1 and improving Wharves I and II were carried out. These resulted in the decision to change the original design of the Oil Port in such a way as to enable the berthing of vessels with laden draughts of 37½-ft. and 34½-ft. at Pier No. 1 and the Wharves respectively, which in turn corresponds to tankers of 32,000 tons and 25,000 tons D.W. Owing to the general importance of the problem, calculations based on extensive statistics were made in order to establish a relationship between the cost of a wharf and the size of vessels using it.

Referring to Fig. 4, the comparative cost investigation embraced three types of oil piers, viz. finger, L- and T-shaped ones, and two types of wharves, namely the common continuous wharf and the marginal type.

The safe berthing of vessels demands a certain minimum length of the fore and aft ropes from which it was assessed that the total length of the wharf or pier required to be 1¼ times the length of the largest vessel. The distance apart of the main berthing jetties was stipulated to be four times the beam of the vessel which in turn was fixed at an average value of b=2.5 d and her length to l=18 d. The minimum length of the pier head or a main wharf section "p" was chosen to be 1/3 l.

h=requisite depth of water=laden draught+2.5-ft.
d=laden draught of tanker
b=beam of vessel
l=length of vessel
p=length of pier head or main wharf section
L=total length of wharf or pier installation
$D_o \ldots D_n$ = Dead weight of tankers in tons
$R_o \ldots R_n$ = Total cost of oil wharf or pier including necessary equipment for tankers of type "o...n"

Putting $\frac{D_n}{D_o} = \Delta_n$ and $\frac{R_n}{R_o} = C_n$ and based upon the empirical exponential equation for the relation of the DW tonnage to the necessary water depth

$$h = 0.864\ D^{0.2469}$$

the author has used a statistical analysis to find a relationship between R, the total berth cost and Δ, the relative size of the vessels to be accommodated. The relationship is demonstrated graphically at Fig. 5, wherein the dotted and full curves are the minimum and maximum values respectively for C.

Curves 1 represent continuous wharf costs, Curves 2 the marginal wharves, Curves 3 the finger jetties and curves 4 the L- and T-shaped jetties.

The degree of uncertainty as regards estimates of this kind, in general, and variable ground conditions as well as specific characteristics of the site will not allow obtaining exact results in respect of the increased cost brought about by the necessity of berthing larger vessels, but with the guidance of Fig. 5 it may be feasible to get to a fairly good approximation.

In the case of the Stockholm Oil Jetty No. 1 the original proposal of 1949 for a finger pier referred to tankers up to 20,000 tons D.W. The considerable augmentation of the size of tankers from 1949 to 1954—when construction was to start—forced the port authorities to reconsider the original scheme. It was therefore decided to make provisions for oil carriers up to 32,000 tons D.W. having a laden draught of about 35-ft., since the necessary water depth of the new Oil Port as well as that of the approach channels permitted the passage and berthing of tankers of this size without appreciable dredging.

This meant, of course, increased construction cost.

$$\text{Assessing } \Delta = \frac{32000}{20000} = 1.60$$

one obtained in the abscissae of Fig. 4, curves 3, upper part,

$$C_{min} = 1.46 \text{ and } C_{max} = 1.52$$

thus, in average, $C \approx 1.49$

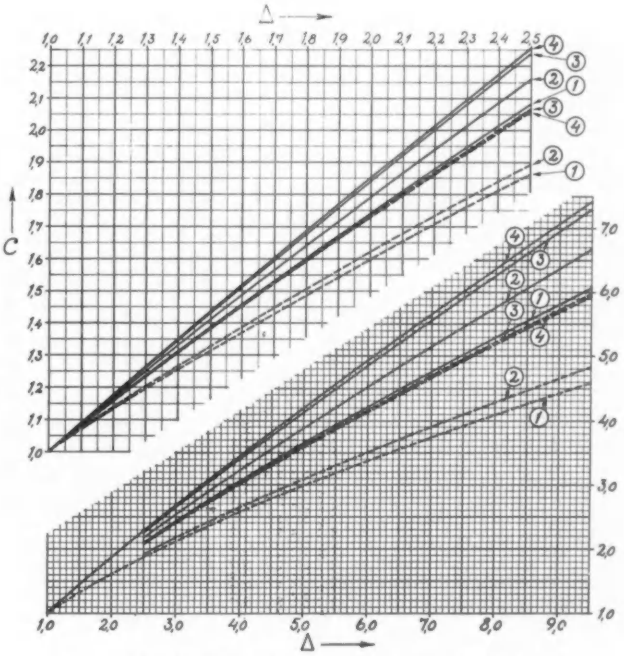


Fig. 5. Relationship between vessel size and wharf cost.

The Oil Port of Stockholm—continued

which resulted in the necessity of securing additional credits amounting to about 49% of the original estimate.

(b) **Total Length of the Pier.**

The requisite minimum length of the fore- and aft-ropes was assumed to be 1/5 of the total length of the largest vessel. Since the length of a 32,000-ton tanker is about 660-ft., one arrived at the necessary distance of 850-ft. between the outermost bollard on the large dolphin and the main bollard situated at the pier root. When determining the above length the influence of the angles β_1 and β_2 (Fig. 3, plan) was also taken into consideration.

(c) **Shape of the Pier Head.**

On the basis of French investigations as well as in accordance with the recommendations of the 1949 Navigation Congress in Lisbon and the British "Model Code of Harbour By-Laws" it was stated that the width and length of the pier head should be 100 and 220-ft. respectively. The latter corresponds to about $\frac{1}{3}$ of the length of the largest tanker to be received. The pier width was chosen in order to satisfy the demands of safety against fire when tankers are moored on both sides of the pier simultaneously and also to provide the necessary space for the equipment of the pier head. This comprises lighting masts, water hydrants, space for temporary stocking of oil barrels, sheds for the metering and control instruments, shelters for the foremen of the pier installation and a store for spare parts, valves and portable foam aggregates for fire fighting. In addition, it was considered important that vehicular traffic could manoeuvre freely on the pier head and this also influenced the choice of width. As a matter of fact, the possible savings attainable by a narrower pier head are not in any way proportional to the reduced width, since the decreased distribution breadth of the horizontal forces unfavourably influences the stability of the structure.

About two-thirds of the seaward deck portion containing the oil discharging equipment, i.e. pipe ends with valves, flexibles, etc., is not accessible for vehicles during unloading. This section is separated from the remaining landward third of the pier head deck by a barrier situated at a distance of 80-ft. from the nearest pipe connection for petrol and aviation spirit and about 60-ft. from the nearest black oil connection.

3. NAVIGATIONAL ASPECTS

After investigation the proposal to turn all vessels before mooring was accepted (Fig. 1). The main advantages of this decision were deemed to be as follows:—

(a) The security against fire demands the quickest possible removal of the tankers from the pier in case of emergency, and when moored bows seawards they may normally sail without awaiting tugboat assistance. Assistance is necessary if the vessels berth with the bows towards land.

(b) It is considered easier and safer to turn a laden ship than a light one, since the screw of an unloaded vessel, being near to the water surface, cannot work efficiently. This is the case especially in stormy weather when the whole ship's side is exposed to the wind.

(c) The stern of the turned vessel is situated right at that part of the pier head accessible to road traffic during the discharging operation. Thus food supplies can be quickly loaded aboard and there is convenient access for the ship's crew.

4. CONSTRUCTION DATA

(a) **Pier Head.**

The substructure consists of vertical and raker steel piles of the Krupp type, filled with plain concrete. They were chosen as being most economical, since tubular piles of the necessary dimensions were not available at that time. (However, for the wharf substructure welded steel pipes are being used). The computation of the box piles was based on the principle of considering the steel area as the longitudinal reinforcement of a concrete pile, but a deduction of 0.2-in. of the steel thickness was allowed to compensate for the computed corrosion over 50 years. In this way a bearing capacity of 100 and 150 tons per axially-loaded short pile was calculated for the KP24 and KP25 sections respectively. The piles were driven to bed-rock by a floating hammer having a 5-ton ram. The maximum pile length amounted to 70-ft. The piles were provided with special shoes and points (Fig. 3) in order to secure penetration of the morainic layer immediately above bed-rock as well as of the somewhat deteriorated rock surface. The maximum pressure on rock, limited to 8.5 tons per sq. in., was based upon tests carried out in a rock chamber previously. The pile penetration per 10 final blows was stated to be 0.2-in. at heights of drop of 5-ft. 3-in. and 8-ft. 9-in. for the KP24 and KP25 sections respectively, the Hiley formula with a F.S.=3 was applied. The piles were computed as end-bearing piles. For the traction of the batter piles a cohesion resistance of 0.7 lb. per sq. in. within the clayey layer and a ratio of 0.35 of friction to weight within the morainic layer were anticipated. Both results were obtained from tests and a F.S.=1.5 was applied. The piles were designed as columns hinged at both ends.

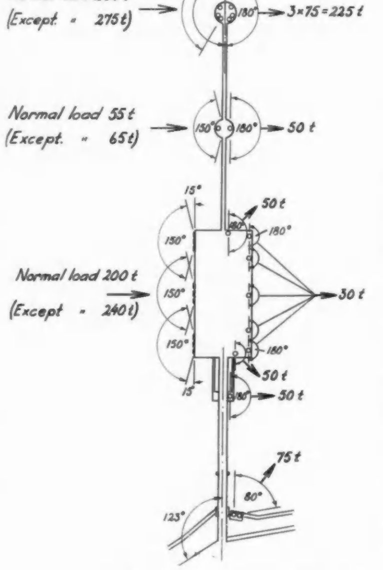


Fig. 6. Design loading.

The pile material consisted of mild steel with an ultimate strength of 25 tons per sq. in. containing an addition of copper of about 0.3%.

The rake of the batter piles was 1 in 3.5 and 4.5. Buckling was computed influencing the bearing capacity of the KP24 and KP25 sections at an unsupported height of 51-ft. 6-in. and 58-ft. respectively.

The concrete topping to the box piles was specially reinforced by 8—10 bars $\frac{3}{4}$-in. dia. connecting them with the concrete cappings which supported the longitudinal main girders poured in situ. The last mentioned structural units constituted the primary part of the superstructure. Upon these girders pre-cast concrete cross beams were placed at 9-ft. 10-in. centres. The pre-cast cross beams were manufactured in two halves of length 47-ft. 3-in. and placed on the main longitudinal beams so that a space of 2-ft. 4-in. above the middle beam was kept free. This portion was poured in situ and the projecting reinforcement of both the longitudinal beam and the half cross beams created a monolithic system. The same procedure was followed in concreting the front beams in situ. The thickness of the deck slab is 6.7-in., 0.8-in. of which is regarded as a wearing surface.

External horizontal forces were assessed at 200 tons distributed on a length of 33-ft. at any portion of the pier head, and the maximum longitudinal mooring force was assumed to amount to 150 tons, originated by three 50-ton bollards (Fig. 6).

(b) **Approach Trestle.**

This part of Pier No. 1 comprises two main longitudinal beams carried on four supports (Fig. 3, elevation G-G). Support 1, at the pier root, is founded upon a group of concrete-filled box piles manufactured by welding together two steel sheet piling sections of the Larssen IV type. All piles were driven to bed-rock.

Support 2 is placed on a group of eight box piles, four of which are vertical and four raking at right angles to the pier head axis while Support 3 comprises a concrete capping placed on 16 vertical and raking concrete-filled steel boxes of the KP24 type. The rake is perpendicular to the pier axis since the bollard pull and ice pressure parallel to the pier axis are taken up by prestressed stiffening beams on either side of the trestle. Support 4 has roller bearings placed on a short cantilever of the pier head structure. In

The Oil Port of Stockholm—continued

the centre of the middle bridge span there is a sliding rocker bearing, permitting a maximum horizontal live load and temperature displacement of 3.4-in. parallel to the pier axis, for transmitting shear stresses from one half of the bridge span to the other. The two main beams carry a prestressed concrete roadway slab with a thickness of 8.9-in. in the middle and 6.7-in. at the ends. On either side of the 10-ft. roadway there are asphalt-surfaced walkways of a width of 2.5-ft. each. From the cantilever ends of the roadway slab—poured in situ—are suspended the H-beams which carry the pipelines (Fig. 3, F-F).

(c) **Outer Dolphin** (Fig. 3).

The dolphin substructure consists of a 36-ft. dia. concrete caisson with a height of 66-ft. and a wall thickness of 8-in. The caisson is provided with a 42-ft. dia. bottom slab, 43-in. thick. The whole caisson was poured by means of sliding forms in a dry-dock about four miles away and towed to the site. Here it was sunk after dredging of the overlying soft clay, and the caisson was then filled with gravel, the sandy layer beneath the caisson being given a cement grout injection. The superstructure of the dolphin consists of a concrete capping comprising two slabs with gravel filling in between and a 31-in. outer wall, all poured in situ. Owing to the high cost of filling material the dredged area around the caisson was not refilled and the stability of the dolphin as well as the caisson walls were computed with consideration to this circumstance.

(d) **Inner Dolphin** (Fig. 3).

This caisson, 30-ft. diameter by 40-ft. in height, was sunk on a gravel fill that replaced the clayey layer removed by dredging. The superstructure consists of a mass concrete capping poured in situ.

(e) **Footway Bridges** (Figs 3, C-C and 7).

These provide access to the two outer dolphins and consist of pre-cast prestressed concrete units of a triangular shape, carrying a 4—5.5-in. footway slab of 6½-ft. width. The length of a beam is 150-ft., and the side wall thickness of the triangular units amounts to only 3.5-in. The bridge units, having a total weight of 55 tons each, were placed on small cantilevers projecting from both dolphins as well as from the pier head.

(f) **Load Assumptions.**

The most important load assumptions, apart from those shown in Fig. 6, were as follows:—

Live load:

Upon the approach trestle and pier head: a uniformly distributed load of 200 lb. per sq. ft. or a vehicle with 11 tons on an axle.

Snow: 20 lb. per sq. ft.

Wind load: 16 lb. per sq. ft.

Ice pressure: 1 2/3 tons per lin. ft.

(g) **Quality of Material.**

Concrete.

The sand, gravel and crushed stone aggregate used were of local origin, and with Swedish standard cement from the Stora Vika factory, concrete of the following minimum cube strengths was specified:—

Prestressed structures: 6400 lbs./sq. in. at 28 days with w/c ratio 0.44.

Precast units: 4260 lbs./sq. in. at 28 days with w/c ratio 0.59—0.62.

In situ work: 4600 to 6400 lbs./sq. in. at 28 days with w/c ratio 0.59—0.62.

Pneumatic immersion vibrators were used throughout.

Steel.

The ordinary reinforcement employed consisted of deformed bars partly of Swedish origin and partly of Czech manufacture (Roxor type) having a yield point of 25.5 and 24.2 tons per sq. in. respectively. The 1-in. and 2/3-in. steel bars used for the prestressed units had an ultimate strength and yield point of 68 and

Fig. 7. Prestressed Concrete Access Bridge.

52 tons per sq. in. respectively and were delivered by the West-German Rheinhausen Steel Works.

Prestressing was carried out on the basis of the Diwidag system and followed the German regulations Din 4227 of 1950-53. Samples of all deliveries were tested at the laboratory of the Harbour Board.

(h) **Manufacture and Erection of Prefabricated Units.**

The pre-casting yard was situated at a distance of one mile from the site where a 10-ton portal quay crane facilitated local transport. Generally Swedish plywood sheets were used for the form work of the pre-cast beams which were provided with lugs and lifted by a 60-ton floating crane into barges which were towed to the site. Here the 60-ton crane lifted and placed the units. The illustration (Fig. 7) shows prestressed concrete Access Bridge unit being placed in position.

The total quantity of concrete used for Pier No. 1 was 3,600 cu. yds., the consumption of deformed bars 210 tons and that of high tensile steel for the prestressed units 22 tons.

5. PIPEWAY AND PIPE CONNECTIONS (Fig. 3, B-B, F-F)

At the pier root on land there is a distributing plant where most of the pipes coming from the two wharf portions and Pier No. 1 meet in order to continue through a tunnel towards the storage tanks. Each pipeway underneath the approach trestle contains two 10-in. dia. pipes for petrol, one 10-in. dia. for aviation spirit, one 10-in. dia. for kerosene, two 10-in. dia. for light fuel oils and motor oil, two 12-in. dia. pipes (insulated) for heavy fuel oils, one spare pipe 10-in. dia. and fresh water pipes. Welded lengths are jointed by flange bolts at 60-ft. centres and expansion boxes are placed at Support 3 of the approach trestle. Beneath the entire length of this trestle the pipes are supported by H-beams, which, in turn, are suspended on the roadway structure (Fig. 3, F-F). The pipelines are carried beneath the pier head deck in the same way so that the optimum deck surface is made available.

Symmetrically on both pier sides there are groups of pipe connections where the pipe ends are to be coupled with flexibles. The latter are 10-in. dia. and in three sections of a total length of 50-ft. In order to facilitate coupling of the flexibles, hose handling frames are erected on either side of the pier head. They consist of steel portals with a welded box section (Fig. 3, section and elevation), having a clear height and span of 30 and 33½-ft. res-

The Oil Port of Stockholm—continued

pectively. Upon these frames the flexibles are suspended by means of hand pulley blocks. Each portal frame has room for a total of 12 flexibles. Along the elevated top girder of the frame there is a light inspection trestle for the repair of the blocks and the painting of the steel structure, as illustrated in Fig. 8.

Beneath each frame there are three prestressed concrete tanks—provided with gratings in the deck surface—intended to accommodate in the event of a hose bursting, a total quantity of 40 cu. yards of oil.

6. PIER EQUIPMENT

(a) **Bollards.**

On either side of the pier there are two groups of main twin bollards with a capacity of 75 tons each. One pair is situated at the pier root and the other on the outer dolphin. Here there are also two single bollards intended for emergency use. On Support 3 of the approach trestle and the inner dolphin there are two single 50-ton bollards. The same type is supplied at both ends of the pier head close to the approach and footway trestles. Alongside the pier head edges five 30-ton bollards are placed for the spring lines.

The 75-ton bollards are of the Swedish standard type; however, for all the other units British Bean bollards were used. They proved to be very suitable from the nautical point of view and are economical owing to the simple method of fastening them into the concrete without discontinuity of the main reinforcement bars.

(b) **Fenders.**

The superstructure of Support 3 and of the inner dolphin was provided with conventional fendering of treated wood consisting of a series of rubbing strips having negligible energy-absorbing capacity, and merely intended for the protection of the structure against occasional bumps of small vessels, e.g. tugboats.

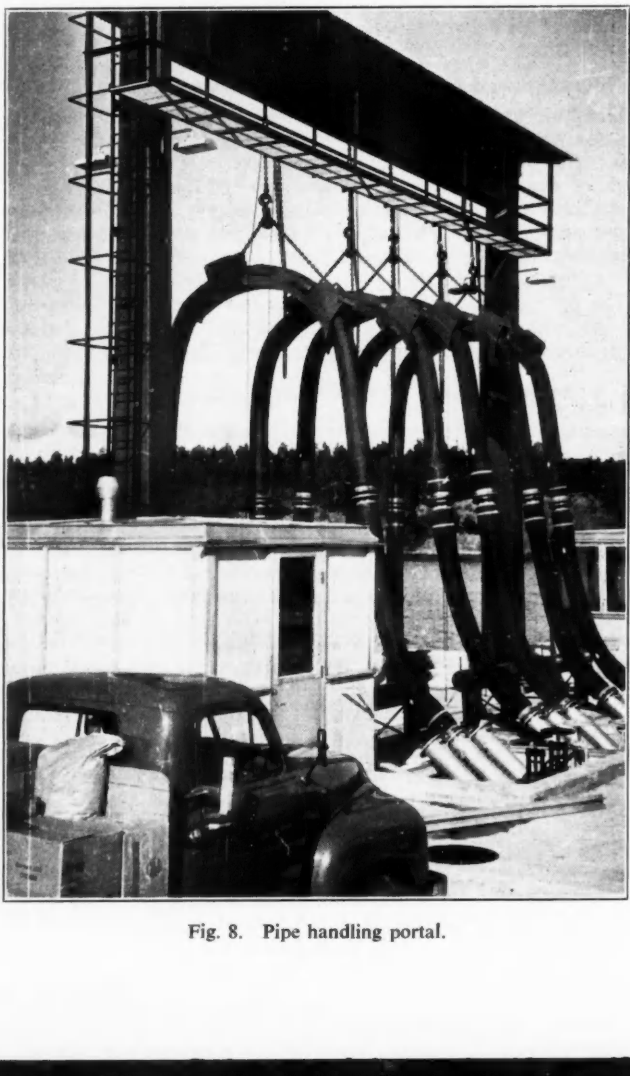


Fig. 8. Pipe handling portal.

The main fendering of the pier head comprises three groups of circular rubber tubing. Each group comprises three horizontal and two vertical units of 15-in. and 7.5-in. outer and inner dia. respectively (see Fig. 3, elevation and suspension detail at the right). They were designed for taking up a kinetic energy of 37.5 ton-ft. per group at a 50% compression of the outermost unit, which brings about an equivalent static impact force of 200 tons per group (see Section 4). The detailed computation of this fender structure is dealt with in the author's report to the XIXth Int. Navigation Congr., London, July 1957, Section II, Question 2. The lower edge of the front beams is protected by a 3-in. x 8-in. continuous hardwood rubbing strip.

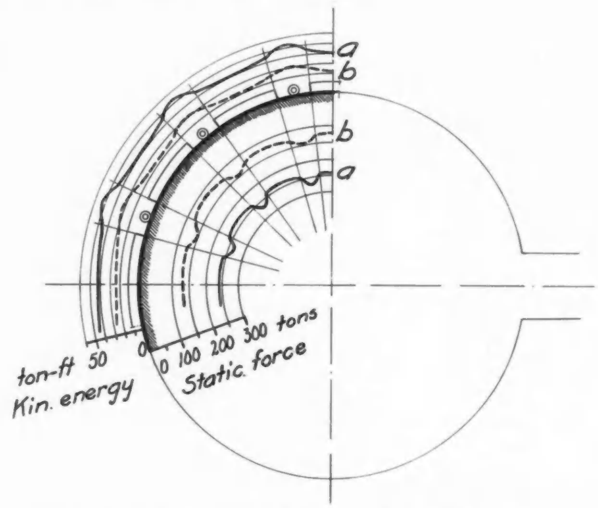


Fig. 9. Energy absorption of outer dolphin fendering.

The design of the fendering for the outer large dolphin followed the principles applied for the pier head. Since the maximum kinetic energy to be absorbed was 41.4 ton-ft., equivalent to a static impact force of 230 tons, two rows of horizontal tubing were required.

A diagram of the impact forces to be taken up by the round-head fender system is shown in Fig. 9. Curve "a" illustrates the values of the kinetic energy and static pressure to be absorbed at a 57% compression of the central portion of the tubing struck by the ship hull. Curve "b" comprises the above values at a 50% compression. Both curves show the variation of impact forces with the position of the blow.

The decision to use the tubular rubber dock fenders was the result of lengthy studies and discussions while the application of a series of other fender systems was thoroughly investigated. Owing to the sheltered position of the Oil Port of Stockholm and to the moderate wind speeds and currents as well as to the total absence of tide, the kinetic energy to be absorbed amounted to a comparatively small figure, and this made tubular fenders economically attractive as regards first cost and maintenance. For the computation of the longitudinal component of the impact on the pier head a friction coefficient of 0.35 was taken into account. This resulted in a force of $200 \times 0.35 = 70$ tons, which was taken by two shortlinked suspension chains $1\frac{3}{8}$-in. diameter. The pier head structure itself resists 150 tons acting parallel to the pier axis.

(c) **Access Ladders.**

These are of Swedish standard type and are placed on both ends of the pier head close to the trestles, on Support 3 and on both dolphins.

(d) **Lighting.**

The jetty is uniformly lighted by means of sodium units with 140-watt tubes. They proved to secure a satisfactory capacity of penetrating fog, smoke and vapour. The total illumination of the pier head comprises 32 units with 140-watt tubes mounted on standards 33 to 42.5-ft. in height.

(Concluded at foot of following page)

Timber Handling at Ports

Bundling Into Unit Loads Advocated

By G. B. CROW

Port Authorities are at a serious disadvantage when applying themselves to the problems of handling timber cargoes, since they are rarely consulted on methods of stowage—and stowage largely holds the key to improvement. There is little choice in the method of stowing grain or ores but in a bulky and widely varying material such as timber, there is scope for alternatives. The Dock Authority's apparent interest may finish and begin at the ship's rail but it is importantly affected by what happens actually on and within the ship.

Timber, in the form of separate items, ranges from pieces 6-ft. long of ⅝-in. x 3-in. softwood weighing 3-lbs., up to round hardwood logs of great girth and perhaps 30-ft. long weighing as much as 10 tons. The limit of length for square softwood logs is commonly 60-ft. but spans of even greater length are not unknown. In between can be found the whole immense range of dimension, shape and weight.

It is not the purpose of this article to consider the problems of the exceptional but to concentrate upon the normal. The specialist will deal with exceptional timber cargoes on the basis of his experience with awkward items in a multiplicity of trades. For the normal, however, it is possible to discuss standardised methods of handling and stowage. Firstly, then, only square-edged timber will be discussed.

Methods which would be appropriate to a Liberty ship cannot be applied to a Dutch coaster, but both may be used for timber cargoes. Some distinction arises, however, from their natural trading routes, and it is generally true that the larger and heavier dimensions of timber originate in countries involving ocean voyages and therefore larger vessels. European shipments, on the other hand, are of the smaller dimensions and require, in the main, shallower draft ships. This broad principle is used in categorising the types of cargo.

From European sources the limits of dimension can be described as 4-in. in thickness, 12-in. in width, and 21-ft. in length. Larger pieces would comprise less than 2½% of the total. From the other continents the same cross-sectional limit but with a maximum length of 24-ft. would cover at least 80% of total shipments. The principal exceptions included in the balance of 20% would be the log timbers originating on the Pacific Coast.

Traditionally stowage of timber in and on a vessel has been manual, piece by piece or (and this is important) bundle by bundle, each being worked into a position that will leave the minimum unfilled space. Timber can only be readily handled from the ends. It is awkward to pick up at the centre and to carry at waist level, though it may be pushed sideways if not overlaid. Smaller pieces may be manœuvred, therefore, by one man, but large pieces need two. For the limits of manual handling the weight of an item should not exceed what two stevedores can comfortably lift, one at each end, from foot level and stow sideways—say 200-lbs.

The smaller the size of a piece of timber below a median point the higher the labour cost in handling. The median point has been established somewhat arbitrarily in stevedoring schedules, and without much uniformity between port and port. This is a subject for a work-study project which could result in much more realistic rates. These would further encourage the shipper to qualify by his methods for the minimum rates, particularly by bundling.

Bundling of small dimensions has been an accepted practice for many years. The stimulus has come from the need to control handling costs at the producing mill, and the cost of bundling has been treated as part of the cost of production. Examples would be softwood slating battens and hardwood dimension stock. As the dimensions of the individual piece increase, however, the manufacturers' interest in cost saving by bundling diminishes and a point is soon reached at which bundling is only carried out at the cost of the buyer.

The buyer, who may be the importer, is only inclined to pay the extra cost of bundling if he can see some advantage to himself by way of savings in freight or discharging and handling costs. With European softwoods, bundling charges may be as much as 4% of the F.O.B. price, yet there is no increase in value **at the point of use** of the material. Further, the shipowner discourages bundling by increased freight rates to cover alleged losses in cargo capacity.

At this stage there is something of an impasse, brought about by the familiar reluctance to experiment, by the dislike of the unknown and the unproven. Until a few brave spirits break the ice, all will go on as before; but there follow a few ideas to sow the seeds of change.

Studies should be made in producing mills of the savings in handling costs, storage, tallying and paper work that offset the cost in labour and materials of the bundling operation itself. The optimum size of bundles, the method and material of the binder, the changes in later operations, all need examination. The wider the range covered and the figures available, the more fruitful will be the later comparisons with the needs of the ship and the stevedore.

Ease of stowage of bundled timber will depend upon the distance between the reach of the crane or derrick and the point of stowage. In a small modern vessel, without 'tween-decks and having large hatch openings, sling loads can be placed close to their final position. But in large vessels, movement from beneath hatches into wings can be considerable and without special equipment the 200-lb. unit weight limit becomes important. Now, however, small fork-lift trucks are being used below decks allowing a big increase in the acceptable weight of unit loads. The practical limit is likely to be set by derrick and shore crane capacity at 3 tons.

The Oil Port of Stockholm – *continued*

7. DREDGING AND RECLAMATION

In order to provide sufficient space for the wharf construction, the access road, and railway tracks, it was necessary to carry out considerable land reclamation. Stone filling, won at the construction of underground oil storage chambers in the vicinity of the Oil Port, was used. The stabilisation of this filling demanded the removal of about 120,000 cu. yd. of soft clay lying above the bedrock or morainic layer. The quantity of rock fill amounted to about 300,000 cu. yds.

Around Jetty No. 1 the requisite dredging amounted to 40,000 cu. yds.

8. ADMINISTRATION

The Oil Port is owned by the City of Stockholm and is at present tenanted by seven oil companies renting the whole area behind the waterfront installations. They have erected a series of sheet-metal tanks above ground as well as buildings for administration and distribution purposes, and make use of the underground storage rooms referred to above.

9. THE OIL IMPORT TO STOCKHOLM

Sweden is compelled to import her entire oil requirements and at present the number of refining plants is limited so that much of the oil supply to Sweden comprises refined qualities. The annual capacity of Jetty No. 1 is estimated to be about one million tons, but with the increasing use of modern vessels, pier capacity should increase to twice this quantity. Table 1 illustrates the development of oil imports to Stockholm, and around 1960 they should reach two million tons.

Table 1

Year	Quantity in tons	Year	Quantity in tons
1938	300,000	1951	940,000
1947	530,000	1955	1,350,000

10. ACKNOWLEDGMENTS

The author is indebted to the management of the Harbour Board of Stockholm for their permission to publish this paper.

The construction work was carried out by the Swedish firm Skånska Cementgjuteriet, Ltd., Stockholm, as main contractor. The contract was based on the lowest offer received by competitive tendering and an alternative proposal by the successful tenderer was adopted.

Timber Handling at Ports—*continued*

Extensive use of bundling and unit packs certainly point to economies in loading and discharging time, the least productive part of a ship's working life.

The next consideration is the possible loss of freight space arising from bundling. It is, of course, assumed that the contents of any one bundle will be of a single length and that bundles of a particular dimension will contain the same number of pieces. By statistical analysis of probability it should be possible to estimate the loss of space to be expected in holds of different sizes, and the estimated compared with experience. Such calculations have not been made before, or certainly not publicised. Clearly there will be some loss of space; but if it is accompanied by reduction of loading and discharging time there could be a substantial net gain, particularly on short voyages.

At this point is is appropriate to mention the inadequate gear commonly used for sling loads of lumber. A single or double rope strop is a poor sort of makeshift even if hallowed by time. Many accidents are caused by pieces slipping out of the centre of the lift through the absence of any restraining pressures. Effective equipment is available consisting of a pair of rigid spaced bearers, upon which the load is built up, and over them two stretcher bars. The lifting ropes are threaded through the ends of the stretchers, pass round sheaves attached to the ends of the bearers, and return to attachments on the stretchers above. As lift is applied the load is gripped firmly between the stretchers and bearers making it impossible for pieces to slip out, even if the centre point of the load has been ill-judged with resultant tipping.

At the Timber Handling Conference held at Manchester the author put forward proposals for a standard set, that would be interchangeable for handling by crane, straddle carrier, fork-lift and lorry. A width of about 40-in. was suggested as a starting point and a limitation of weight to within 3 tons.

It is too early yet to reach any conclusions on the suitability of these figures for unit loads as cargo. There is, however, no reason why an attempt should not be made at adoption for discharging timber cargoes of normal stowage. Stevedores customarily prepare sling loads on chocks, both on deck and in the hold, and pass the doubled rope sling under it. With no more difficulty rigid slings 40-in. wide of the type described above could be used. There would then arrive on the dockside, or in the barge, an unbound unit load which could be successively rehandled mechanically, without change, up to the point of storage or resorting. The potential speed and economy is obvious.

The way of the pioneer is expensive but the costs of experiment can be limited if the objectives are broken down into a series of sectors to be dealt with one at a time. The following would be a logical programme.

(1) Study of the cost/savings ratio of bundling at producing mills up to " alongside the vessel."

(2) Determination of the optimum size of bundle or unit pack to minimise loading costs and loss of freight space.

(3) Reconsideration of stevedoring and freight schedules to relate the rates to the cost of the services provided for categories of items.

(4) Experiments in standard sets made up on the ship.

I.C.H.C.A. is already taking a close interest in these problems and a conference is projected, to be held at Stockholm at the end of May, to discuss them. This body is the natural forum for the Shipper, the Ship Owner, the Dock Authority and the Importer to bring their diverse views together for solutions of overall advantage. It deserves full support.

New Quay for River Tyne.

It was recently announced that the Tyne Improvement Commission has approved an application on behalf of the Anglo Great Lakes Corporation Ltd., to build a quay at Newburn Haugh, which is situated a few miles upriver from Newcastle. The proposed quay, which will be 300-ft. long and 60-ft. wide and able to accommodate vessels of up to 600 tons, will serve a new graphite factory which is to be established in the vicinity.

Improvements at Canadian Ports

Anticipating St. Lawrence Seaway Trade

The Shipping Federation of Canada recently held its annual meeting. In his presidential address Mr. Dudley Page reported that satisfactory progress was made during the year in the improvements to port facilities, some of which were designed to meet the changes in the trend of cargo movement anticipated when the St. Lawrence Seaway was completed.

The President said that in 1956, cargo liners trading to the eastern Canadian ports continued to maintain regular and frequent services to the principal countries oversea. Total cargo, import and export, handled at the national harbours, showed a substantial increase over the previous year, with an appreciable increase in the vessel tonnage handled at these harbours. A marked increase in shipments of export grain was a gratifying feature of the year, the increase at St. Lawrence and Canadian Atlantic ports being substantial. Total deliveries of all grains from the elevators controlled by the National Harbours Board showed a heavy increase over the figures of the previous year.

Transatlantic passenger carryings to and from the eastern Canadian ports was a feature of the year's operations. Total passenger travel was considerably higher and immigration figures were also on the upgrade, with prospects of a continuous steady flow of selected immigrants during the present year. In the course of 1956 large new passenger vessels entered transatlantic service between eastern Canada and the United Kingdom, indicating the faith of the passenger liner companies concerned that the Canadian route was becoming increasingly attractive to the transatlantic traveller.

Favourable Turn-Round.

Referring to the turn-round of ships, Mr. Page said he was glad to record that their eastern Canadian ports compared favourably with many seaports elsewhere. The construction of the St. Lawrence Seaway progressed satisfactorily during the year, and completion of that vast project was still scheduled for the opening of St. Lawrence navigation in 1959.

The Federation continued to maintain close contact with the National Harbours Board, Ottawa, in connection with improved port facilities at the national harbours in the lower St. Lawrence and on the Canadian Atlantic seaboard. The Board's programme of improvements, some of which were designed to meet the changes in the trend of cargo movement anticipated when the St. Lawrence Seaway was completed, made satisfactory progress during the year. In addition, new transit sheds, pier and grain elevator facilities, at Montreal and elsewhere, were being constructed to cope with existing traffic, and some of them were expected to be available for service in 1957.

Considerable progress in improving the St. Lawrence Ship Channel between Montreal and Quebec, and in that part of the Channel below Quebec, was made by the Ship Channel Branch of the Department of Transport, Ottawa, during the past year. Widening of certain sections of the Channel was completed, and satisfactory progress made in other sections covered by the Department's long-term plan of channel improvement. A substantial amount of maintenance dredging was also performed during the year to facilitate the safe navigation of ships, especially in low water periods. During the 1956 season of St. Lawrence navigation, water levels in the channel were slightly lower than in the preceding year, but well above the extreme low water level of 1934.

Dredging Contract at Port Kembla.

It has been anonunced that the New South Wales Minister for Public Works has approved a tender of £A915,559 for the dredging of the inner harbour at Port Kembla. Work is expected to commence at the end of this year. It has been stated that the building of the inner harbour, in what is now Tom Thumb Lagoon, will eventually cost £A15 million. Readers will recall that last month this Journal published an article describing the projected improvement works at Port Kembla.

Improvement and Development of the Suez Canal

9th Programme Makes Provision for Deeper Draft Vessels*

FOREWORD

By Sir F. ARTHUR WHITAKER, K.C.B., M.Eng., M.I.C.E.

For close on a year now the world has been disturbed politically by the unrest caused in all the great, and many of the lesser, countries by the seizure on the grounds of nationalisation by Egypt of the property and equipment of the Suez Canal Company. There has not been any suggestion, either at the time of the seizure or since, that this step had been forced upon Egypt through failure of the Company to meet the growing demands of world traffic on the Suez Canal. That such a suggestion, if it was ever made, was wholly without foundation is clearly shown in the article in this issue, which gives details of major developments being undertaken by the Company up to the time when their control was so abruptly terminated. The magnitude of the works, which were then in hand, to fit the Canal for the traffic desiring to use it was indeed great and yet they were only one major step in the continuing pattern of improvement contemplated by the Company.

After the last war, owing to the enormous losses of shipping at sea and following the disruption of world trade, there was a short period when the Canal adequately met the demands made upon its facilities. But as soon as world conditions improved and the Middle East oil became an increasingly important factor in the world's economy, the forecast of the Canal's traffic showed the necessity for greatly improved facilities if trade was not to be driven in part to the Cape route. The oil traffic increased abnormally with a definite trend to larger and still larger tankers, and it was this development that has created the need for an improved Canal.

Engineering works of magnitude take many years to carry out, making it vital to forecast and anticipate the needs of the future. The Suez Canal Company were alert to this and, helped by the advice of an International Works Commission, on which three British maritime engineers have the honour to serve, they have formulated plans in their proposed 9th Programme for the next major stage of the Suez Canal's development. This Programme of Work is imperative if the Suez Canal is to hold its place as an international seaway. There is as yet no sign that the Egyptian authorities, if they retain full control, are prepared to go on with the development of the Canal and one fears that an attempt will be made to use the huge cost of the work as justification for increasing the tariffs for shipping. Such an outlook would lead to protracted negotiations and add force to the contention of the many who advocate the creation of a tanker fleet of great dimensions sailing via the Cape. There is much to be said for such a fleet shipping by the all-sea route from the Middle East to an entrepôt port, where transhipment could take place into smaller tankers serving the neighbouring countries. And in Milford Haven this country has an harbour which could provide the depths required, without material dredging, and which could serve the whole of Northern Europe.

Introduction.

WE have recently been asked to give an account in the "Dock and Harbour Authority" of the way in which the Suez Canal Company had planned the future of the Canal in regard to the expansion of oil traffic. Readers will remember from an article which appeared in the July, 1955, issue, that an extensive series of works, composing the 8th Improvement Programme, had been in progress since the beginning of 1955. We will briefly recall the features of this programme and the stage it reached, and shall show how its execution has been affected by the events which recently upset, and subsequently stopped, the operation of the Canal.

We shall then explain the considerable expansion of oil traffic to be expected during the next fifteen years, as appears from an intensive survey carried out at the Company's request in all the economic circles concerned. We shall follow with a description of the 9th Improvement Programme, of which preliminary plans had been drawn up by the Company during the first half of 1956, within the framework of continuous improvement of the waterway with the object of converting it into a two-way canal from sea to sea. We shall show that the execution of this programme would have made it possible to handle the expected traffic, and that in normal conditions it could, in spite of its magnitude, have been completed before the expiry of the Suez Canal Company's Concession.

Finally, we shall try to see very briefly the possible effects of the recent events on the problem of the transport of Middle East oil to the West and on the conditions governing the use of the Suez Canal.

1. The 8th Programme.

The object of the 8th Programme, which was approved in December, 1954, was to allow the passage of a daily average of 48 vessels, with peaks of 56 ships. Its aim was also the normal transit of vessels drawing 36-ft., which corresponds to tankers carrying approximately 40,000 tons. On completion of this programme, originally envisaged for 1960, the Canal would have provided passage for 110 million tons of oil annually, as against 60 million tons in 1954.

The works, which were well ahead at the end of July, 1956, included the cutting of two by-passes to take the growing numbers of ships, and the general adaptation of the navigation channel to accommodate vessels of increasing size.

The new Port Said by-pass, viewed from the south. The illustration shows, in the background, the Mediterranean; centre, the town and docks of Port Said; foreground, left, the main canal and, right, the new by-pass, 3 km. (1¾ mls.) long.

* Translated from an article in French, specially prepared by the Suez Canal Company.

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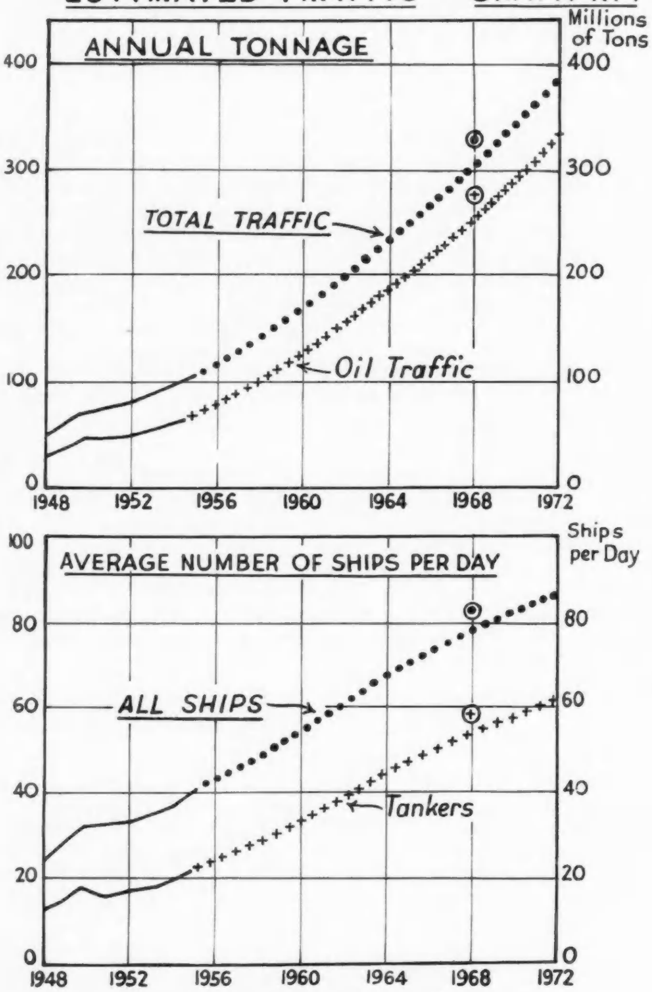
ESTIMATED TRAFFIC – GRAPH No. 1



The sign ⊙ or ⊕ indicates Canal capacity after completion of the 9th Programme.

(a) The Port Said by-pass, at the southern end of the harbour, was to be about 2½ km. (1½ miles long). Out of a total of 7 million cubic metres (over 9 million cubic yards) 5 million cubic metres (6½ million cubic yards) had been excavated by the end of July, 1956. This by-pass was to have been opened at the end of 1956.

(b) The Kabret by-pass, in the south of the Great Bitter Lake, was at first planned to have been 3 km. 700 (approximately 2¼ miles) long, but this was later increased to 8 km. (approximately 5 miles). This by-pass was practically finished in July, 1956, as there remained less than 200,000 cubic metres (about 261,000 cubic yards) out of 8 million cubic metres (about 10½ million cubic yards) to be excavated.

The general adaptation of the navigation channel by widening and deepening was intended to increase the underwater cross-section by 15 per cent. to 30 per cent. according to situation, thus increasing its area to between 1,450 and 1,700 square metres (1,700 and 2,000 square yards). For a ship of 36-ft. draft and a midships section of 310 square metres (370 square yards), the minimum ratio of the underwater cross-sections would therefore be about 5. The new channel was to have a minimum guaranteed depth of 13 m. 50 (44-ft. 3-in.) and a minimum width of 60 m. (197-ft.) at this depth. In July, 1956, work was in progress in the central and southern Sections over a length of 30 km. (18½ miles). About 2 million cubic metres (2,600,000 cubic yards) had already been excavated out of a total of about 12 million cubic metres (15,670,000 cubic yards) for the Sections concerned.

Over the whole of the Canal, three firms of contractors or groups of contractors, in addition to the Company, were working on this programme. Three suction dredgers with cutter-heads were operating on the Port Said by-pass, three bucket dredgers were at the Kabret by-pass. On the widening and deepening sites the contractors were using 3 dredgers, 3 draglines, of which 2 were Marion 7,400's with 70 metre (76 yard) booms and 6 to 9 cubic metre (8 to 12 cubic yard) buckets, as well as numerous scrapers, including 2 of 23 cubic metres (30 cubic yards). The Company itself had in service a large marine suction dredger with 2,800 cubic metre (3,600 cubic yard) hopper, a powerful suction dredger with cutter-head, 4 bucket dredgers and two rock-breaking pontoons.

Finally, tenders had been invited for 1st August, 1956, for the second stage of enlargement of the channel, covering 60 km. (37 miles) and involving about 20 million cubic metres (26 million cubic yards) of dredging.

These works were thus progressing normally, or rather ahead of programme. It was planned to increase the maximum authorised draft in the Canal from 35-ft. to 35-ft. 6-in. at the end of 1956, and to 36-ft. at the end of 1957. The two new by-passes were to be opened at the end of 1956 and it was expected that the 8th Programme would be completed during 1959, that is to say one year ahead of original expectations.

As a result of the "nationalisation" of the Company at the end of July, 1956 the tenders were left in abeyance, and the effect of the events which followed was to slow down, and then to stop the works completely. This has produced a grave situation in view of the urgent necessity that the 8th Programme should be carried through.

2. New Prospects of Traffic.

In 1955 the forecasts of expansion of oil traffic, made in the economic circles concerned, showed a considerable increase over those made in 1953 which had served as basis for drawing up the 8th Programme. Table 1 shows the rate of this expansion over the last three years and stresses the increasing important place taken by supertankers.

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(4) Total of petroleum products (in tons)	31,681,104	33,862,568	40,167,706
(5) Number of tankers of 34-ft. draft and over	63	175	300
Ditto as percentage of loaded tankers in (3) above	3.89%	9.42%	14.54%
(6) Corresponding tonnage of petroleum products	1,871,000	5,142,651	8,954,768
Ditto as percentage of total petroleum tonnage in (4) above	5.90%	15.19%	22.29%

* Attention is drawn to the fact that, generally speaking, traffic figures are at higher levels during the first months of each year.

A study of tankers being built or on order at 1st August, 1956, shows that this expansion will continue. Numbering 690, they represent a deadweight capacity of 19,200,000 tons, or 45 per cent. of the total capacity of the tanker fleet in service at that date, estimated at 43,000,000 tons. Among those 690 tankers are included 4 of 50,000 tons, 7 of 65,000 tons and 3 of 85,000 tons. One of the latter, the "Universe Leader," was recently put into service. 254 m. (832-ft.) long, 38 m. (125-ft.) wide, with 14 m. (46-ft.) draft, she requires a crew of only 50 men, whereas the T2 tankers, built in great numbers during the war, of 17,000 tons

Improvement and Development of the Suez Canal—continued

deadweight, 160 m. (525-ft.) in length, 21 m. (69-ft.) wide, and 30-ft. draft, need a crew of 40. Finally, it is reported that orders have been placed recently for a 100,000 ton tanker and another of 105,000 tons; the dimensions of the latter are said to reach 286 m. (938-ft.) length and 41 m. (134-ft.) width, with a draft of 49-ft., and its speed 18 knots, compared with 14½ knots for a T2 tanker.

It was indispensable, in face of this rapid expansion, to investigate the probable features of traffic to be expected in the near future. Indeed, the number and the speed of ships on the one hand, and the size of the largest ships to be admitted to the Canal on the other, are the two essential parameters forming the basis of any plans for development of the Canal. On the first depends the choice of passing places and the organisation of convoys. On the second depend the dimensions to be given to the navigable channel.

The Canal Company therefore called in a firm of specialists, "Ebasco Services Incorporated," who were commissioned to make an intensive Survey in all the appropriate economic circles. This firm submitted its Report in January, 1957. To reach their conclusions, Messrs. Ebasco first of all surveyed the economic trends in the regions interested in the Suez Canal; this was followed by a study of the development of oil production, and the transport of oil by sea, particularly (under normal conditions) via the Suez Canal. The Report includes a comparative analysis of the cost of oil transport from the Middle East to the West by the Suez route, by the Cape route and by pipe-line. Finally, the Survey deals with the future development of the tanker fleet, its composition, and the characteristics of tankers.

Table 2 and the graph (Fig. 1), based on the Ebasco Survey, show the probable development of Canal traffic, of the average daily number of transits, and of certain features of the world tanker fleet.

TABLE 2.

	1956	1960	1964	1968	1972
(1) TRAFFIC THROUGH THE SUEZ CANAL					
Total traffic (in million tons)	120	170	234	306	392
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Per diem	43	55	68	78	87
Loaded tankers in proportion to total traffic	27%	29%	32%	34%	35%
Average deadweight (in 1,000 tons d.w.)	19	22.5	24.6	27.8	32.1
(2) WORLD TANKER FLEET					
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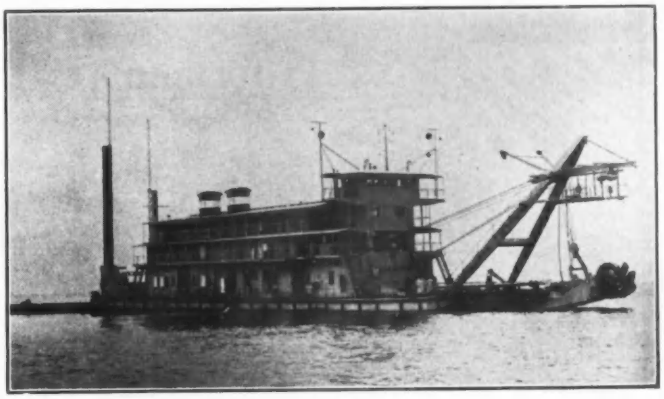
Average speed of tankers (knots)	14	14.7	15.2	15.7	16.5



Suction dredger, with cutterhead, "Louis Perrier." Pump 3,300 h.p.; cutterhead 500 h.p.

The Ebasco Survey also reaches the conclusion that if, by 1972, vessels drawing 39-ft. could pass through the Canal, the latter could, in practice, take any ship wishing to transit, as tankers of over 50,000 tons deadweight would normally use the longer routes which do not go through the Canal.

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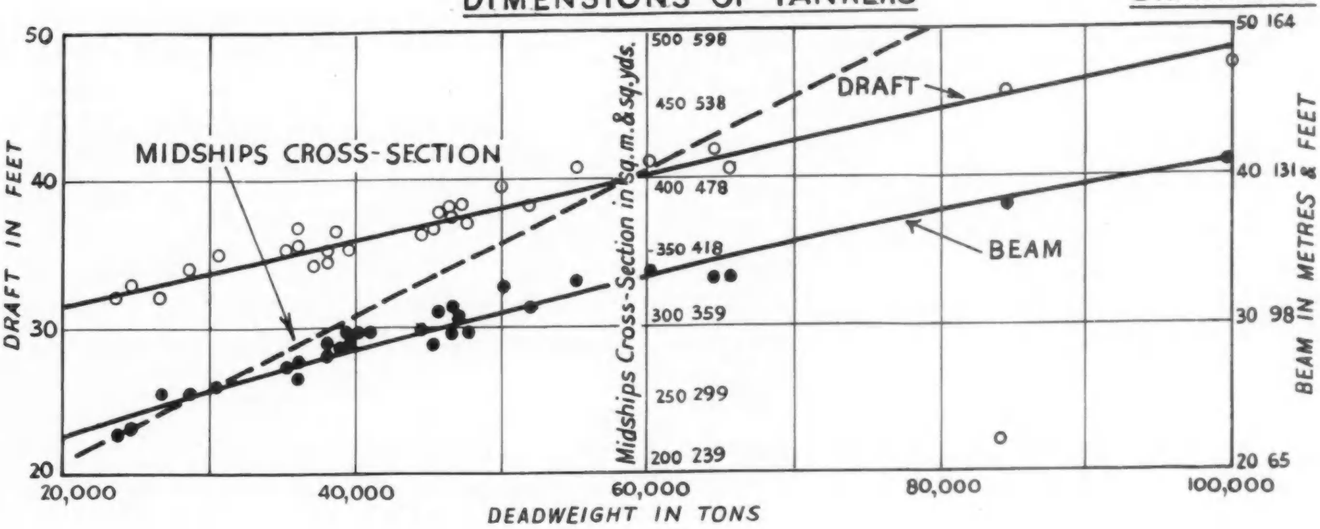
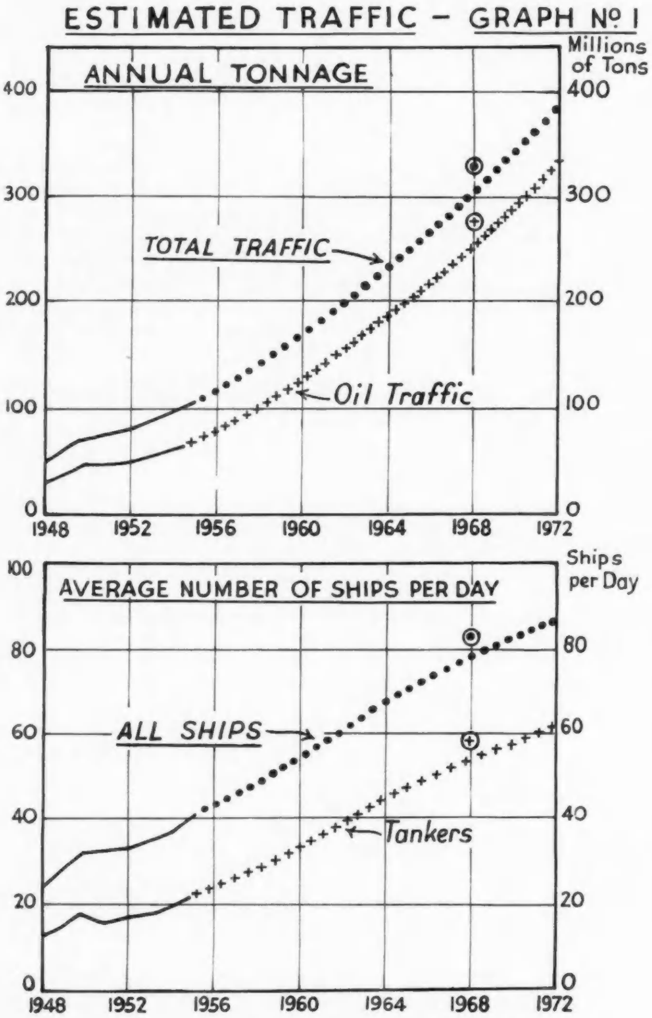
DIMENSIONS OF TANKERS GRAPH No. 2



Improvement and Development of the Suez Canal—*continued*



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Improvement and Development of the Suez Canal—continued

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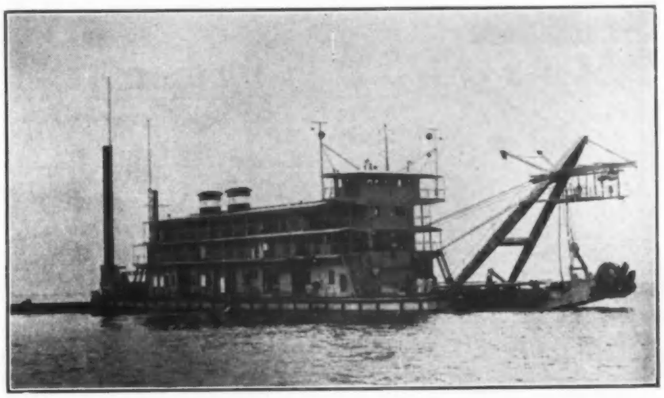

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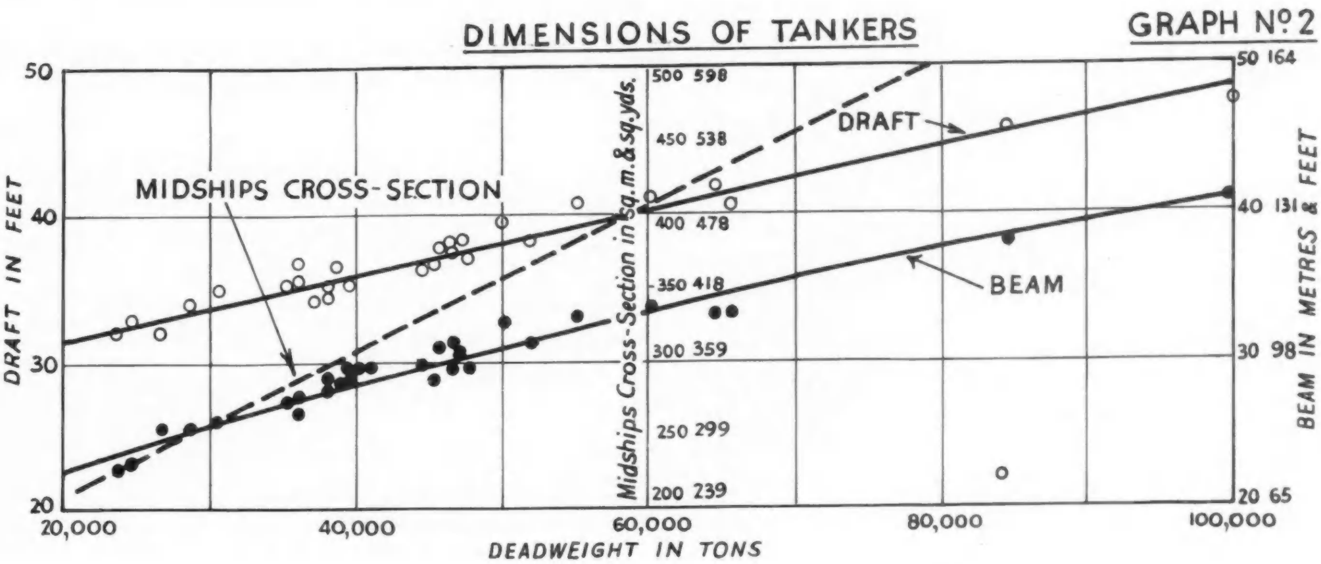

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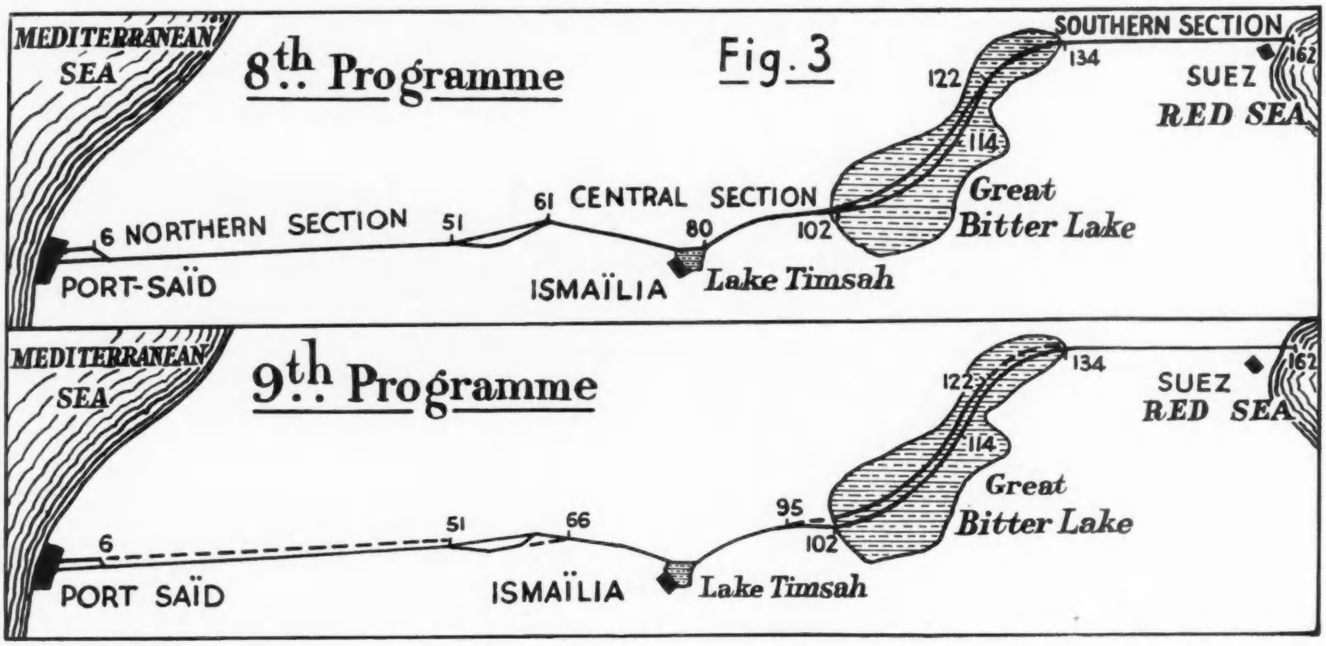


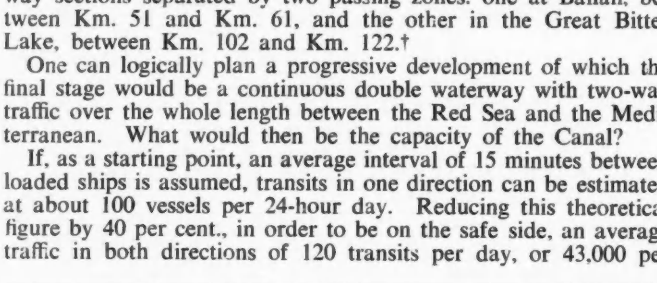
We are now going to explain the lay-out of this preliminary draft of the 9th Improvement Programme. Furthermore, we should point out that it has been submitted to the Suez Canal Advisory Works Commission. This is an international body comprising 18 independent experts of eight different nationalities which, in its normal session of 1956 approved, with certain observations and suggestions as to detail, the broad outline of these preliminary plans.

3. **Plan for Continuous Improvement of the Canal.**

As shown on Fig. 3, the Canal at present comprises three one-way sections separated by two passing zones. one at Ballah, between Km. 51 and Km. 61, and the other in the Great Bitter Lake, between Km. 102 and Km. 122.†

One can logically plan a progressive development of which the final stage would be a continuous double waterway with two-way traffic over the whole length between the Red Sea and the Mediterranean. What would then be the capacity of the Canal?

If, as a starting point, an average interval of 15 minutes between loaded ships is assumed, transits in one direction can be estimated at about 100 vessels per 24-hour day. Reducing this theoretical figure by 40 per cent., in order to be on the safe side, an average traffic in both directions of 120 transits per day, or 43,000 per annum, could be expected. Of this aggregate one could assume that 40 per cent. would be loaded tankers, of an average deadweight of at least 35,000 tons (say about 32,000 tons of actual cargo) corresponding to an oil traffic exceeding 500,000,000 tons per annum. The potentialities of the Suez Canal can therefore be viewed with confidence for a long time ahead, subject to suitable adaptation.



One of the two draglines operating on Canal widening in the southern section.

† After the opening of the Kabret by-pass.

But until the plan for a double waterway from sea to sea has been carried out, the Canal will comprise alternating one-way and two-way sections. The problem is therefore to make provision for an extension of the two-way sections and a reduction of the one-way sections in such a manner that their respective traffic capacities shall balance and correspond to the traffic which must be provided for.

Certain observations arise in this connection. The length of the one-way sections is not the only limiting factor in the capacity of the Canal. By organising larger and less frequent convoys the Canal potential can be increased, although this will entail an increase in the waiting time of vessels at the Canal approaches. This is a secondary method of adaptation to the ever-increasing traffic, which will certainly have to be adopted to handle the huge volume anticipated in the future.

On the other hand, in the present circumstances, the central and southern Sections can be considered as independent as regards the operation of the Canal, for large numbers of vessels can tie up in the Great Bitter Lake. This does not apply, however, to the northern and central Sections, and a mishap in the one speedily brings traffic to a halt in the other. For the great volume of traffic anticipated it is considered that it would be advantageous to have a simpler system of operation, including only two one-way sections entirely independent of each other.

Finally, it must be pointed out that, if less than a certain minimum length, the maintenance of a one-way section becomes difficult, the time available for this purpose between convoys being too short. For example, under present conditions, with a convoy speed of 8 knots, it seems that the minimum length of a one-way section would have to be 30 km. (18½ miles); this indeed would allow only 4 hours per day for maintenance, divided into two periods.

To sum up therefore, it would appear that a suitable lay-out, pending the final stage of a continuous double channel from sea to sea, should include only two one-way sections of about 30 km. (18½ miles) each in length, separated by an area in which numerous vessels would be able to moor, transit being effected by one convoy a day in each direction. Such is the general framework of

Improvement and Development of the Suez Canal—continued

the 9th Improvement Programme, which we shall now examine in greater detail.

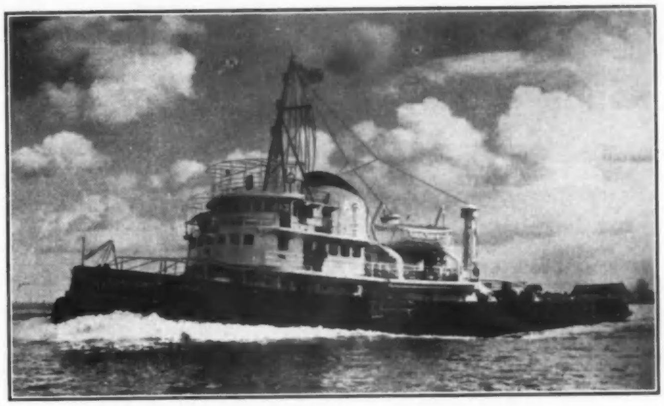
4. **9th Improvement Programme.**

The dotted lines in Fig. 3 show the extensions to the two-way sections proposed in this project. The two one-way sections remaining are the central and southern Sections, separated by the Bitter Lakes, their lengths being reduced to about 30 km. (18½ miles) each. The aggregate length of the two-way sections would thus be increased from 32 km. (20 miles) to 101 km. (63 miles).

Traffic at the rate of a single convoy per day in either direction, as shown in Fig. 4, would permit an average of 83 transits per day, or 30,300 per annum. Under such conditions, the Canal could handle an annual oil traffic of over 275,000,000 tons by 1968, increasing to 320,000,000 in 1972 as a result of the increase in average deadweight for the same number of tankers.

One might obviously have considered the retention, as one-way sections, either of the northern and central Sections, or of the northern and southern Sections. The capacity of the Canal would remain the same, but in both cases the work involved would be much more extensive. Indeed, in the scheme adopted, the work of dredging and excavation lies mainly in the northern Section, where the banks are low and the ground is even and particularly easy to work.

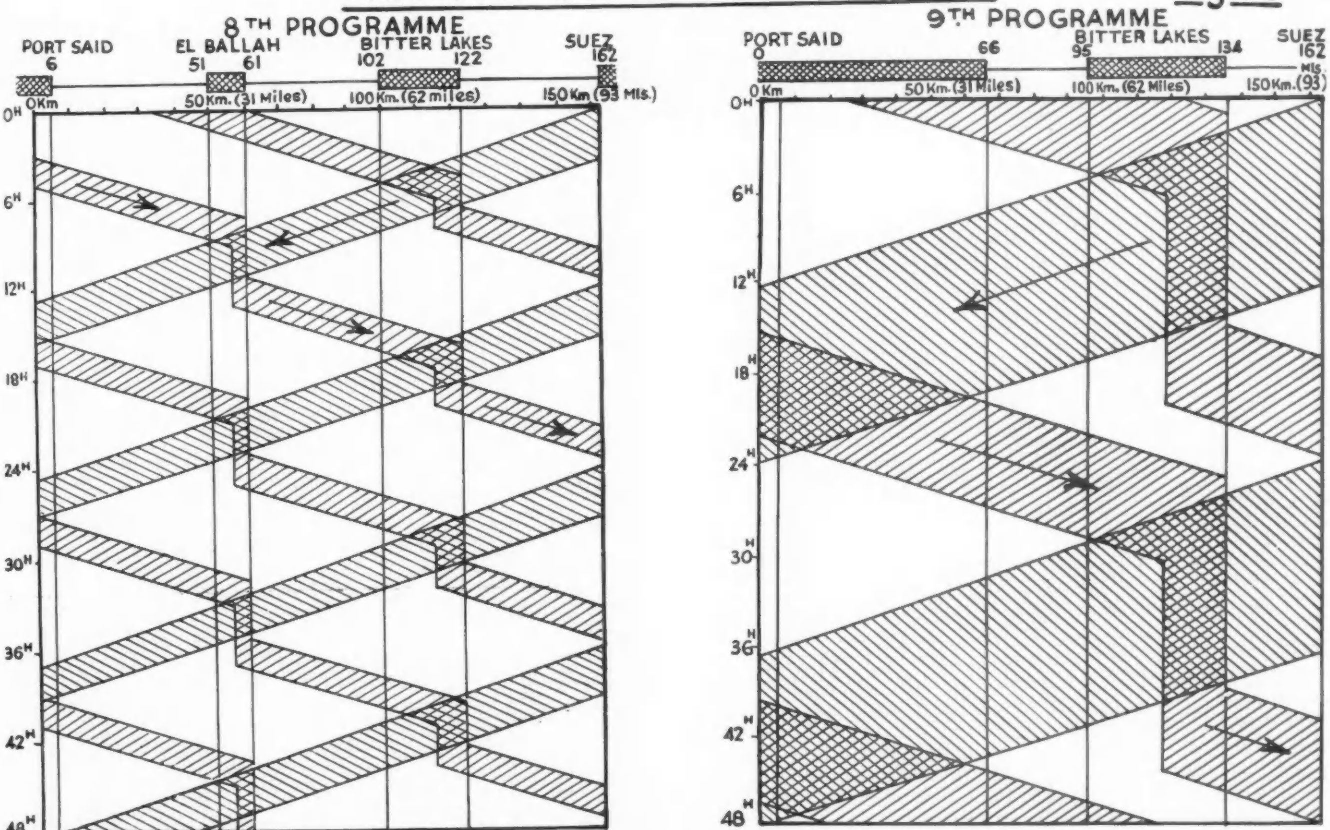
Finally, we should point out that the 9th Programme might provide for an intermediate stage, comprising a third one-way section, between Km. 22 and Km. 51. With two convoys daily in each direction this intermediate stage would permit an annual oil tanker traffic of nearly 200,000,000 tons by about 1965.



The tug "Edgar Bonnet."

Now let us examine the dimensions planned for the navigation channel to allow regular transit of tankers of the type defined above: 60,000 d.w.t., 40-ft. draft, 32 m. (105-ft.) beam. Unless

TRAFFIC OPERATION PLANS Fig. 4

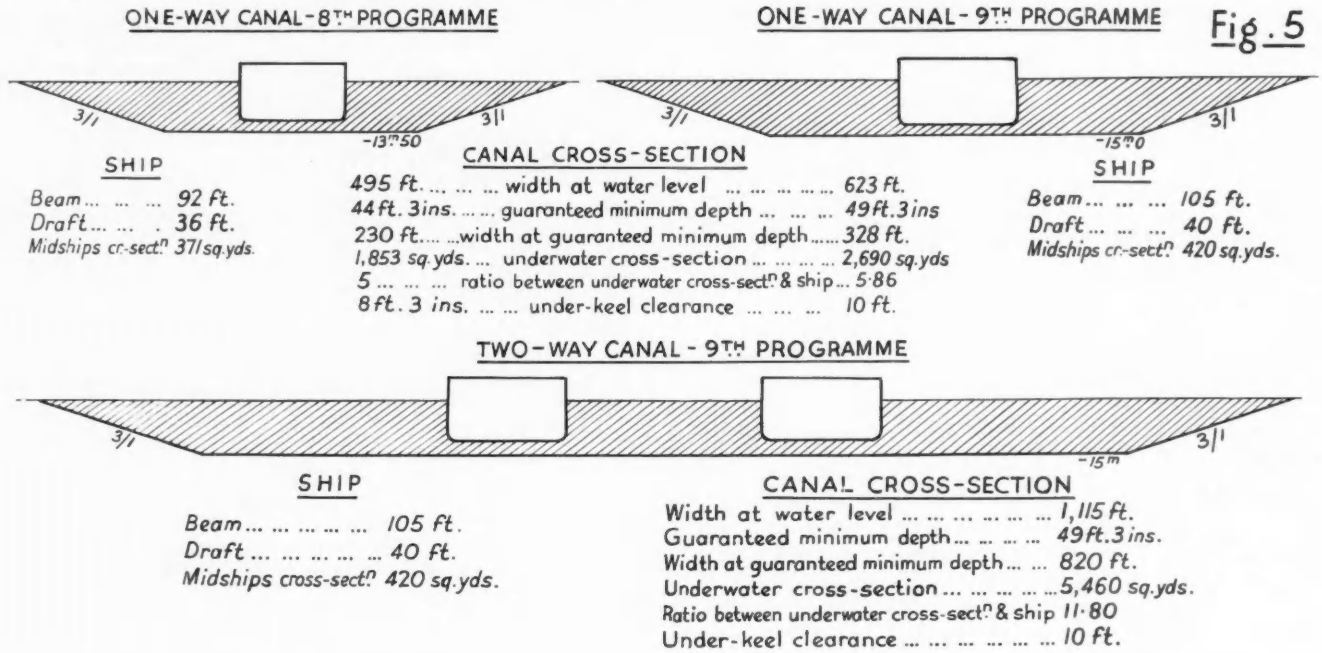


4 Convoys ... ... Number of Convoys per Day ... ... 2 Convoys
56 Ships per Day ... ... Theoretical Maximum Traffic ... ... 96 Ships per Day
48 Ships per Day ... ... Maximum Traffic which would be practical ... ... 83 Ships per Day
110 Million Tons ... ... Annual Oil Traffic ... ... 275 Million Tons

AVERAGE STAY IN CANAL

12H 30 ... ... South North 12H 30
18H 30 ... ... North South 26H 00
15H 30 ... ... AVERAGE 19H 15

Improvement and Development of the Suez Canal—continued



modified as a result of more detailed study, these dimensions would be as shown on Fig. 5, which also gives the measurements of the navigation channel after completion of the 8th Programme.

The minimum guaranteed depth would be increased from 13.50 m. (44-ft. 3-in.) to 15 m. (49-ft. 3-in.), giving a minimum under-keel clearance of 3 m. (approximately 10-ft.) for the largest vessels when stationary. In the one-way sections the width of the Canal at its greatest depth would be 100 m. (328-ft.) corresponding in general to a widening of 40 m. (131-ft.). The minimum underwater cross-section, in a typical area such as Toussoum, would be 2,250 sq. m. (2,690 square yards), an increase of 45 per cent. The ratio of the cross-section of the Canal to that of the vessel would increase from 5 to 5.8.

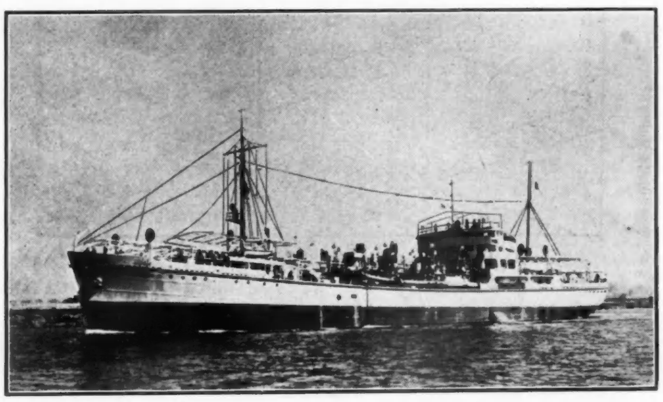
There are two alternative methods of providing the two-way sections; these could consist either of two single channels each confined to uni-directional traffic, or of one canal of very great width in which the convoys would pass each other. In the latter case, the width of 250 m. (820-ft.) at the guaranteed depth of 15 m. (49-ft. 3-in.), as shown on Fig. 5, is given merely as an approximation, but the bottom width would be of about this order of magnitude. Other things being equal, this figure of 250 m. (820-ft.) corresponds approximately to the conclusions drawn from the investigations as a reduced scale model carried out in 1948 by the Panama Canal engineers in connection with the sea level canal project.

The choice between the two alternatives entails a comparison between their advantages and their drawbacks. With two separate canals no collisions can occur and very serious mishaps are therefore avoided. On the other hand, each of the two separate canals would be of comparatively moderate dimensions, which would lead to difficulties in steering, to risks of grounding, to inevitable erosion of the banks and underwater slopes, and consequently to rather onerous maintenance commitments. The second canal would have to be dug at a fair distance from the present canal, since the spoil from the maintenance of the western canal would have to be placed on the strip of ground between the two canals; in certain areas, with a space of, say, 300 m. (984-ft.) between, the ground level would be raised by 4 m. (13-ft.) after a lapse of only 25 years.

The great advantage of a single canal of considerable width is that it permits great freedom of navigation, the ratio between cross-section of the canal and that of the ship being in the neighbourhood of 12. Normal navigational risks and the burden of maintenance would be considerably lessened. Unfortunately, however, this alternative does not eliminate the risk of collision, which would be serious, in view of the magnitude of tanker traffic and the system of transit in convoys. A ship can navigate on a course off the axis of a canal only with a permanent helm angle. If this angle is too great, the freedom to manoeuvre is restricted accordingly. Convoy navigation entails one vessel passing another every seven minutes or thereabouts. It is therefore essential that this manoeuvre shall be simple and safe and it is advisable to study this problem more closely. It is equally advisable to study minutely the problem of buoying or lighting, as this governs the safety of the crossing of convoys by night.

Finally, it may be observed that if the proposed dimensions are adhered to, the two alternatives would involve approximately the same amount of dredging and excavation. On the other hand, the alternative of two separate canals would necessitate the construction of junction cross-overs, in addition to the construction of three new revetments for the protection of the banks, whereas with a single canal only one new revetment would be called for.

We should mention here that the Suez Canal Advisory Works Commission, at its annual meeting in 1956, whilst calling for a more intensive study of the two alternatives, expressed a certain degree of preference for that of a single canal of very great width; for this it suggested trials on a reduced-scale model as well as full-size experiments on a stretch of the Canal itself.



Marine suction Dredger "Paul Solente." Length 367-ft. Capacity of wells 3,584 cu. yds.

Improvement and Development of the Suez Canal—continued

Apart from the development of the Canal proper, the magnitude of the traffic anticipated by about 1970 calls for certain ancillary works, especially at either end of the Canal.

At Port Said the 9th Programme envisages an increased number of berths, which will be made possible by the removal of certain islets, as well as the enlargement of certain docks and the construction of berthing quays, in order to facilitate loading and discharge. Provision is also made for the construction of a direct outlet to the Mediterranean which would avoid north-bound vessels having to traverse the full length of the port, where the majority of them have no commercial operations to carry out. This direct channel would skirt Port Fouad to the east. A newly-constructed eastern breakwater would protect this new channel as far as the point of junction with the main channel.

At Suez a complete re-arrangement of the roadstead is planned, comprising an extension of the mooring zones, the cutting of a new channel, and improvements to the buoyage. In this area, which is outside the Company's Concession, it will be advisable to control the movement of vessels and to organise a roadstead pilot service, if an increase in collisions and groundings is to be avoided.

Finally, retention of the swing bridge spanning the Canal at Km. 68 is incompatible with the increase in traffic at present forecast. For this reason the 9th Programme provides for its replacement by a combined rail and road tunnel, to be constructed under the Canal.

5. **Conditions under which these works could be carried out.**

For the Canal proper, exclusive of the ancillary works, the execution of the 9th Improvement Programme entails the following approximate quantities of work:—

- 70 million cubic metres (91½ million cubic yards) of excavation.
- 300 million cubic metres (392½ million cubic yards) of dredging.
- 120,000 metres (131,000 yards) run of embankment protection.

Works of great magnitude are therefore involved. Would it have been possible to carry them out in good time, despite the approaching expiry of the Company's Concession, and without unduly hampering navigation?

Beyond all doubt the answer to this question is in the affirmative.

The plans could have been completed in a year, taking into account the suggestions put forward by the International Works Commission, which had already approved the general lines. The intention therefore was to submit the scheme in definite form for further examination by the Commission at its regular session in November, 1957, after which the actual work could have been put in hand in 1958, simultaneously with the completion of the 8th Programme.

In view of the rate of increase of traffic and the necessity for completing the improvements envisaged by about the time the Concession was due to terminate, some 30 million cubic metres (39¼ million cubic yards) of spoil would have to be removed annually. From our experience of recent years it can be accepted that, given a carefully planned organisation plus the availability of powerful plant, this rate could indeed be maintained without undue interference with traffic. It would have been necessary, for instance, to plan for the use of large suction dredgers with cutter-head, of the "Louis Perrier" type.

As for the cost, it is anticipated that this would amount to nearly £100 million. This indeed represented a very substantial investment, bearing in mind the approaching end of the Concession. Nevertheless, as receipts were expected to increase in proportion to traffic, whilst working expenses would have increased less rapidly, such an outlay could have been covered by ploughing back profits, without any alteration in the transit tariff, always provided that the general conditions of operation of the Canal had remained without any major change until 1968. It is true that the Board had not yet had to decide on the implementation of this programme. But, in the circumstances just set forth, it is certain that such a decision, rendered both necessary and possible by the increase in traffic, would have been duly made and carried into effect, in conformity with the Company's traditions and its constant concern for ensuring with the greatest efficiency the important public service for which it is responsible.

In conclusion, it is interesting to examine briefly how the recent events which have affected the functioning of the Canal may modify the results of these studies.

It is certain that the search for oil will be intensified in regions of greater political stability. Hence there may result a certain reduction in the rate of development of Middle East production, but this will probably affect pipe-line transport more than carriage by sea.

Nevertheless, the fact remains that from the economic point of view new and substantial Canal development works are necessary, even if other considerations impel shipowners and countries concerned not to wish to be too dependent on the Canal and to accept, a priori, for part of their oil traffic, the burden entailed by a diversion to the Cape route. In any case, a stimulus will have been given to the tendency already evident among shipowners to build larger and larger tankers.

It will no doubt become necessary to amend the Ebasco estimates regarding future Canal traffic, as also the provisions of the 9th Improvement Programme drawn up by the Canal Company. Nevertheless, this scheme remains valid in broad outline, and constitutes a sound documentation for any future study.

It must again be stressed that there is little time to spare. It is disquieting to realise that tankers of 36-ft. draft were expected to transit the Canal towards the end of 1957, that this will not be so, and that a halt has been called to the works of the 8th Programme and to the further studies of the 9th Programme. These works are urgent, and their execution will give rise to problems which will be all the more difficult because of the setback and because there will be less time available.

Those upon whom the operation of the Canal devolves should give due consideration to this without further delay.

The Dock Disputes in Australia.

When tabling, in the House of Representatives, the report of the Australian Stevedoring Industry Authority for the year ended June 30th, the Minister for Labour and National Service announced that more time was lost by disputes on the Australian waterfront in 1955-56 than in any year since the war. He said man-hours lost through disputes amounted to 8.6 per cent. of total man hours worked, compared with 6.6 per cent. in 1954-55, the previous worst year.

Time lost for the six months from July to December last, at 5.7 per cent., was also very high. Some improvement had occurred in the last quarter of 1956, and that had continued into the first quarter of 1957.

The authority's report stated that the Australia-wide dispute between January 23 and February 14, 1956, had caused the loss of 2,224,159 man hours. This was 66.3 per cent. of the total man hours lost in 1955-56 through wharf disputes.

Attendance money paid at Australian ports, at £532,033, amounted to 24 per cent. of total wages over the year

It was stated that a notable trend in recent years in inter-state trade had been the decline in the tonnage of general cargo. At the same time, there had been an increase in inter-state iron and steel cargoes such as iron ore, coal and limestone.

Sea carriage of general cargo had traditionally provided the major avenue of employment for waterside labour in inter-state trade. But it had been declining at an accelerated rate since November, 1954, because of increased competition from rail and road transport.

The report added: "The threat of road and rail competition is a challenge to the efficiency of stevedoring operations. Unless freight rates are kept within reasonable economic limits, more of this trade will be lost to road and rail transport. If for no other reason than self-preservation, those engaged in stevedoring operations have a joint responsibility in arresting that loss."

The Australian Stevedoring Industry Authority has taken over the activities of the former Australian Stevedoring Industry Board.

The Clean Air Act and Ships in Port

Responsibilities and Problems Involved*

The Institute of Marine Engineers was one of nineteen societies which supported the clean air conference recently organised by the Institution of Mechanical Engineers. The purpose of the conference was to discuss "The mechanical engineers contribution to clean air." This was considered necessary because enforcement of the new act in the near future will necessitate action in one way or the other by technically responsible persons, including every type of mechanical engineer.

One of the papers given by R. Atkinson, D.S.C., B.Sc.(Eng.), A.M.I.Mech.E., M.I.Mar.E., and L. Baker, D.S.C., M.I.Mech.E., dealt with air pollution due to ships in port and resulted in a brisk discussion which reflected the entirely different viewpoints of shipping interests and port health authorities

Causes of Smoke Nuisance.

Atkinson and Baker state that smoke nuisance from ships in port is not one of the major problems faced in trying to get cleaner air in industrial areas but it is one of the most difficult to solve. This is due to the transitory nature of ships. Frequent lighting-up of cold boilers and as frequent shutting-down, cause smoke emission of greater or lesser blackness. Furthermore, apart from the problem of main smoke is that of the sulphur content of that smoke, which tends to be higher with fuels bunkered abroad.

Private correspondence with port health inspectors showed that five main causes of smoke emission exist. These refer to coal and oil-fired steam ships and no mention is made of motor ships. The causes of smoke nuisance, in order of frequency, are: lack of supervision on arrival; operation at reduced boiler loads; mechanical defects; raising steam; and unsatisfactory combustion conditions in natural draft plants converted from coal to oil.

A typical instance of lack of supervision on arrival was quoted. All engineer officers were busy preparing to go on leave or attending to urgent repair schedules, and for the time being overlooked the need to pay attention to satisfactory combustion conditions. In another instance the engagement of a shore donkeyman who had not become familiar with the run of work and the peculiarities of air and fuel supplies and burner operation, was stated to be the cause of the trouble. Generally a few words of instruction from the engineer-in-charge was sufficient to cause a rapid abatement of smoke emission. This fact was taken as confirming the view that smoke emission on arrival could be more satisfactorily controlled, if given adequate supervision. The second most frequent cause of smoke emission, use of boiler to provide steam for auxiliaries whilst the others are "blown down" for voyage repairs and cleaning, is generally due to excessive cold air entering the funnel through open smoke box and furnace doors. Shutting these doors gives immediate improvement. The third most frequent cause, wear and defects of forced draught machinery and shutting down of fans for repairs, is responsible for a marked increase in the density and volume of emitted smoke, which may last several hours until completion of repairs.

Little need be said about raising steam in cold boilers. This is due to allowing the steam pressure to run down overnight or during a weekend, followed by increasing air and fuel supplies. When normal steam pressure has been restored the smoke nuisance ceases. The least frequent cause of smoke nuisance is the occasional trouble resulting from unsatisfactory combustion of oil in a converted natural draft boiler. The remedy is to employ a forced draught system.

Clean Air Enforcement Problems.

Atkinson and Baker base their views of existing regulations upon the results of enquiries amongst authorities in port areas. These suggest that the present existing legal machinery is inadequate, and, in fact, impotent. As a result of complaints or routine inspections, observations are made of a ship. Where smoke emission is excessive the normal practice is for verbal caution to be given to the engineer in charge and usually this suffices to obviate further trouble. If the ship is a habitual offender, however, the procedure is the same as that for smoke nuisances from buildings.

It is stated, on the authority, of a port health inspector, that "very few cases of smoke nuisance reach the courts. The reason for this can be understood when one considers that a ship may only visit a port at long intervals and only remain for a short time and that the procedure for dealing with smoke nuisance can be a very protracted business.

Between 30 and 40 smoke nuisances caused by ships are dealt with, in an informal manner, annually at this port. The vast majority of vessels concerned used oil for boiler fuel and during 1955 all the smoke nuisances were related to vessels burning this fuel." One of the largest port authorities stated that "During the last ten years there has been only one reported case, to this authority, of excessive smoke made by a vessel on the river, and in view of the explanation given (a temporary fault in the fuel combustion system) no action was taken against the offenders."

In New York two of the regulations applying to all ships and floating equipment whether using the waters or moored to piers and docks are: hand-fired boilers to use solid fuel of specified volatile content; and the prohibition of dense smoke altogether and limit less dense smoke to only 2 minutes per hour. The regulations apply also, to any air contaminent, including but not limited to smoke, soot, flay-ash, dust, fumes, gases, vapours, nuisance odours, that may be a detriment to the property of others or that may be a nuisance to any person not directly therein or thereby engaged.

Turning to the new Clean Air Act, the authors said that, in their view this did not seem to be much of an improvement on existing legislation. In their paper it states that under the new act the Port Health Authorities are charged with the responsibility of ensuring compliance. Previously the powers were vested in the Medical Officer of Health of the Boroughs in which the docks were located, with the result that it was virtually impossible to secure a conviction owing to difficulties of identifying offending vessels. According to the authors it will still be difficult to secure a conviction until the offending vessel has been notified.

Kinds of Ships Involved in Air Pollution.

Coal-burning tonnage is decreasing rapidly and is largely restricted to coastal shipping and trawlers and to a few foreign-going ships 25 years of age and older. There are also a small number of war-time built ships not yet converted to oil fuel. Between 1948 and 1955, according to Lloyds Register Book (1954-1955), coal-burning steamships have dropped in numbers from just over 12,000 to about 2,500. In the same period oil-burning steamships increased in numbers from about 7,600 to 9,700. In addition mention should be made of diesel ships. These are of two types, those burning boiler oil fuel, and those burning marine diesel or gas oil. Oil-burning steam ships have main boilers, and may have steam-driven or electrically-driven deck gear through auxiliary or donkey boilers. Motor-ships too, may have steam or electrically-driven deck gear and both types of ship may have steam for boiler and tank heating purposes. In the ultimate oil-burning ships resolve themselves into three categories, distinguished by the source of steam in port: (a) a main boiler used for port load, with steam or diesel generators; (b) an auxiliary boiler used for port load, with steam generators; and (c) a donkey boiler used for port load, with diesel generators.

The paper describes the problems of smoke-less combustion in coal-burning ships. It includes all the problems of smokeless combustion ashore, together with added complications due to a falling standard of firemen and lack of experience amongst sea-going engineers and officers. The quality of coal varies very widely. It is less washed and graded than before the war and best marine coal is rarely seen today. With lack of uniformity, different air control techniques are required according to the type of coal actually in use. However, this is beyond the skill of firemen, notwithstanding excellent pre-sea training by the Shipping Federation. The Naval tradition of firing "little and often" has never been acceptable to merchant service routines owing to long standing prejudices.

* The Conference on "The Mechanical Engineers Contribution to Clean Air" was held in London on February 19th—21st last, and was attended by nearly 500 people.

Clean Air Act and Ships in Port—continued

For port use the donkey boilers of the older ships were often originally installed to a bare minimum in size and are now inadequate with the increase in steam consumed, owing to the old age of the plant. For this reason, heavy smoking results when attempting to increase the head of steam at periods of peak load. Fortunately the number of coal-burning ships is decreasing, and the more serious problem, which is likely to remain, is that of coal-burning tugs, considerable numbers of which remain in British waters. Tugs are subject to wide load variations and are quite unsuited to the use of coal as a fuel, the correct burning of which requires steady load conditions. Unfortunately it is not always practicable to convert tugs to oil fuel economically, owing to lack of draught and lack of space for the installation of fans.

Boilers and Oil-burning Equipment.

The authors were careful to differentiate between main, auxiliary and donkey boilers. Main boilers are normally for the provision of steam for the main engines; auxiliary boilers for auxiliary steam usually operate at main boiler pressure but occasionally at that of the deck machinery. Donkey boilers are small boilers, usually of the shell type, providing steam heat to tanks, domestic purposes, etc. and operated, as a rule, at 100 lb. per sq. in. or less.

The economics (and hence, to some extent, the potential smoke emitting characteristics) of main boilers depend on the relative size of the port steam load and on the ships operating cycle. Tankers have a short port turn-round time and it is seldom practicable to do more than essential " patching " between annual overhauls. Auxiliary boilers capable of carrying substantial loads are therefore not necessary so there is no case for any smoke nuisance by tankers. With passenger and cargo liners the problem is different. These ships frequently use one of their main boilers in port. However, port load, in this case, is well under 50% and may be only 10% of rated load. It is difficult to avoid smoke unless the oil-burning equipment is designed to permit this to happen at reduced boiler loads. This is seldom so and there is a case for greater attention to detail during the design stage with the aim of avoiding smoke difficulties in harbour.

Efficient smoke-free operation of auxiliary boilers on modern ships should be possible, because these are generally suitably sized and give the required output at 50% to 75% full load. In older ships, however, auxiliary boilers are incapable of smokeless operation even with perfect combustion equipment, because of lack of draught and the excess steam requirements of worn deck machinery, etc. Donkey boilers too, are very often causes of serious smoke emissions.

During the last 10 years the characteristics of bunker fuels have greatly changed. Oil-burning equipment, installed perhaps 20 or 30 years ago, is no longer suitable. This problem is accentuated by low standards of maintenance for oil-burning equipment and for these reasons smoke is frequently present where none is really necessary. Many steamships now in use are equipped with obsolete oil-burning equipment and ships being built at present are often equipped with registers which are not able to effectively deal with present-day bunker fuels. Donkey boilers are even less satisfactory, as the majority have burners designed for light fuels.

Recommendations.

A number of recommendations were made by the authors, with the aim of reducing smoke emission from oil-burning ships. In many cases new and up-to-date oil-burning equipment is necessary. In general the plant operates at too low a pressure (oil and air). Six general lines of improvement are possible:

(1) Training of personnel.
(2) Use of modern pressure-jet equipment.
(3) Use of modern rotary cup burners.
(4) Improved atomisation.
(5) Use of automatic controls.
(6) More attention to maintenance.

Among the suggestions made were:

(1) More attention should be paid to stokehold operators, perhaps by extending the training scheme of the Shipping Federation.
(2) Adequate means be fitted to all ships for observation of smoke, e.g. periscope type smoke observation fittings. These would provide positive observation and reduce the necessity for observers to go to specific points to observe smokestack conditions.

DISCUSSION

Amongst those who participated in the discussion of the paper were Commander Cooper and Captain Hewson. Commander Cooper said that he had been dealing with the problem of smoke emission from ships in port for nearly 20 years. This problem was foremost in the minds of ship owners, masters and chief engineers. It should not be thrown at the feet of the operators involved. One cannot expect them to be fully qualified combustion engineers. It is too much to ask of such people to put together the various facts at the necessary speed, when " things start to happen " and smoke is being created. What is needed is a very simple apparatus, as opposed to anything which needs adjustment.

The speaker went on to say that he would like to see a survey carried out with the aim of identifying the actual offenders and determining the numbers of offenders in ports. " Although there now are a smaller number of coal-burning ships do they make less smoke?" He then drew attention to ships without supplies of electricity for auxiliaries whilst in port. " Is smoke made when ships with steam-driven auxiliaries are in harbour or whilst backing out?" From the speakers' observations well over 50% of the smoke made in harbour was whilst lighting up. This process often takes 3 to 4 hours. He made a number of suggestions regarding lighting-up methods and concluded by stating that more attention should be paid to air casing leakages and to the training of operators.

Captain Hewson spoke on behalf of the Chamber of Shipping of the United Kingdom. The shipping industry was in entire sympathy with the object of the Clean Air Act, he said. However ship owners are realistic people and although desiring to assist in reducing air pollution, had to face the fact that the legislation in question was primarily to deal with land conditions, and it was often difficult to apply such legislation to ships, because of the circumstances under which they operate. This applied particularly to coal-fired and oil-fired natural draught ships, because of the sudden demands for power when manœuvring on or off a river berth. " In these circumstances " continued Captain Hewson, " shipowners have perforce to apply for some degree of protection by way of regulations, while accepting the fact that the act will mean some sacrifice from their industry, as from other industries. During meetings with the Ministry interested in the Clean Air Bill the shipping representatives had agreed to the imposition of a scale of maximum periods during which certain ships were exempted when emitting smoke. These periods are so small that they can only be fulfilled by exercising the utmost vigilance. It is therefore to be regretted that the authors of the paper refer to them as " loopholes."

He went on to say that " by and large " ships trading to New York were able to comply with the local requirements regarding smoke emission, although difficulties did sometimes arise. However, there were practically no coal-burning ships in that area, otherwise they would not be able to comply with the New York regulations. " Reference was made to coal-burning ships by the authors " he continued. " They are agreed that little can be done and are content to gloss it over with a pious hope that coal-burning ships will soon be extinct." While agreeing with the authors that they are most difficult ships to deal with, I would point out that there are a considerable number of coasting ships still in existence, and that their expected life is another 20 to 25 years. Moreover, they are in and out of port so frequently that they are aways with us. Owing to the inferior quality of present-day coal, the "unknown quantity " of imported foreign coal, together with the frequent changing of firing personnel, it is imperative that the shipping industry should have some protection. It has been mentioned that ships reduced their smoke during the war when lives depended on it. And indeed it was reduced, although it could not be entirely eliminated. But they may have to be just as vigilant to save our liberty.

New Drydock for Emden, Germany

Designed for Ship Construction or Repair*

WITH over forty launchings since the war and a large order book for new vessels, the "Nordseewerke Emden GmbH" have moved into the front rank of major German shipyards. This company, which celebrated its 50th anniversary in 1954, is the largest of its kind in the East-Frisian area. It is playing a prominent part in the revival of the local economy and of the port of Emden, whose post-war economic recovery is seriously affected by the keen competition of Bremen and the ports of the Benelux countries. After the war, only a limited number of floating docks and graving docks for ship repair and shipbuilding purposes were available in the North Sea ports. When restrictions on German shipbuilding were eased by the Allied Control Council, the "Nordseewerke Emden" decided immediately to build a dry-dock. Having regard to the trend towards ever-increasing size in the construction of liners, cargo vessels and tankers, the dock was designed to accommodate a vessel of 38,000 tons deadweight capacity, and the leading dimensions adopted were as follows:

Effective length of dock between inside of gate and head of dock	218 m.
Clear width over whole length of dock	32 m.
Depth of dock floor below mean water level in harbour	8.20 m.
Height of keel blocks (which can be altered to suit special cases, however)	1.20 m.

A dry-dock can be used both for repairing ships and for the construction of new ships. It is a structure into which a vessel can be sailed as into a navigation lock; after the water has been pumped out of the dock, the vessel settles down on to keel blocks and is supported laterally by means of bilge supports. The essential components of a dock are the dock chamber (the actual working space), the dock gate, which in the present case takes the form of a caisson gate, the flooding and dewatering installation (pump-house), and the dock equipment (crane tracks, cranes, bollards, capstans, electrical distribution system, etc.).

The dry-dock design for which tenders were invited was prepared by Professor Dr. A. Agatz, Bremen, and Dr.-Ing. E. Lockner, Bremen. The latter was also responsible for the final design and calculations.

The work was executed by the Dockbau-Arbeitsgemeinschaft Emden, an association of companies comprising Hochlief-AG (the sponsor company), Köhncke & Co., Bremen, and Neumann Bros., Norden. In addition, Messrs. Joh. Keller GmbH, Frankfort-on-Main, were the contractors for the ground-water lowering, anchoring and vibratory compaction operations, and Messrs. Heinrich Riemann, Oldersum, were the sub-contractors for the excavation work.

All site control duties for this project were undertaken by the works construction department of the "Nordseewerke Emden." Thus the planning and supervision of the construction and fitting-out operations were done by the dock owners themselves.

In the longitudinal direction the body of the dock is divided into ten blocks 21.0 m. in length. The dock entrance forms a separate unit, which also contains the pump-house with the flooding and dewatering equipment and which furthermore serves to accommodate the caisson gate.

The joints between the individual blocks are provided with a "joggle," or key, and contain a 15 mm. thick filler of bitumen-impregnated felt. The entry of ground-water is prevented by a multiple seal: at the bottom of the floor slab the joint is closed by an "Aleuta" metal strip; some distance above this is inserted a "Sika" ribbon-type water-stop (No. 3 section); and finally the upper part of the joint is plugged with a 7 cm. thickness of tarred rope which was run in with a special bituminous compound and is sealed at the surface by a lead caulking held against two flat steel strips embedded in the concrete.

In cross-section the chamber of the dock is a reinforced concrete trough-shaped structure, designed to resist bending moments but capable of elastic deformation. The chamber is of rectangular section over the whole length of the dock. The floor slab at mid-span and the side walls are 2.00 m. thick. The tops of the walls accommodate service ducts; these ducts are large enough to enable a man to walk through them.

In contrast with navigation locks, which generally cannot be dewatered, dry-docks have to resist the full uplift exerted by the ground-water when the chamber is empty and must be designed accordingly. Up to the present time this problem has been solved —unless it is proposed to effect permanent relief of water pressure under the floor, which is very expensive in operation—either by making the weight of the structure with its superimposed loading greater than the effective uplift ("gravity" design) or, alternatively, by preventing uplift of the floor by the provision of a large number of tension piles. In the present case, however, a new method was applied in actual practice for the first time. On the whole, this method is a very economical one.

The concrete sections of the floor and walls have been kept very thin, being only 2.00 in thickness. The deadweight counteracting the water pressure is therefore small. The residual uplift is now taken up by so-called floor anchors which are prestressed against the subsoil. These anchors consist of a reinforced concrete anchor block of cruciform section and tapering to a point at the lower end (dimensions: 1.35 m. x 1.35 m. and 1.22 m. in height). A patent-locked steel cable is concreted into these anchor blocks. The cable, which is made of grade St. 140 high-tensile steel supplied by Messrs. Felten & Guilleaume, Cologne-Mülheim, consists of 84 separate wires and has an overall diameter of 46 mm.; it is provided with seven-fold protection against corrosion. The upper end of the

Fig. 1. General view of Dock.

* Translated from the German.

New Drydock for Emden, Germany—continued

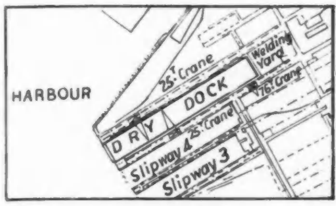


Fig. 2 - Key Plan.

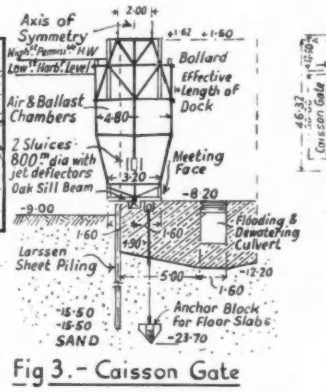


Fig 3. - Caisson Gate

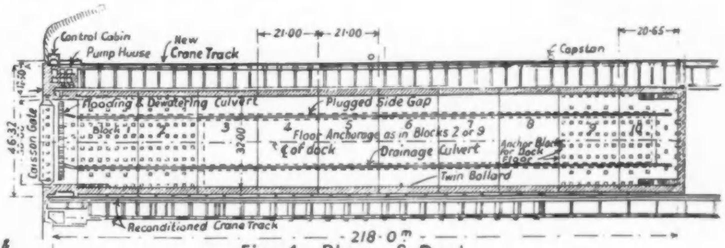


Fig. 4 - Plan of Dock

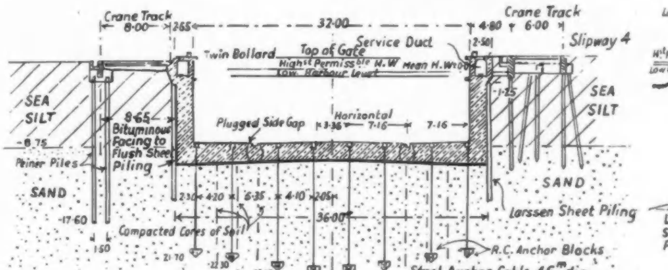


Fig. 5 - Typical Cross Section of Dock.

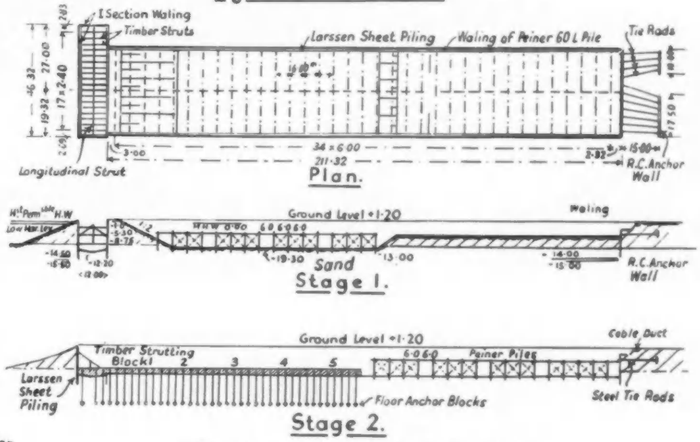


Fig 6 - Construction Procedure.

cable is embedded in a special socket. The anchor blocks were jetted and vibrated into the sand subsoil to a depth of 11—14 m. below foundation level with the aid of the vibroflotation process (vibrator-jetting deep compaction), the ground being thereupon thoroughly compacted by additional vibration at various points. The ends of the cables were left projecting from the formation to a height of 0.50 m. below finished floor level and were enclosed in sheet-metal ducts in which they could slide on being tensioned after the floor slab had been concreted and had hardened. The cables were prestressed to a force of 105 tons with the aid of a special jack and were anchored by means of their sockets. After the cables had been tensioned, the cable ducts were injected with a sealing compound. The special cable sockets are so designed as to permit subsequent checking of the prestress and, if necessary, re-tensioning of the cables. The working load of an anchorage cable is 95 tons. The additional force of 10 tons to which the cable is intially tensioned is intended to offset creep losses in the steel and in the connecting devices.

By this procedure of tensioning the anchorage cables and thus prestressing the floor against the subsoil (German Application for Patent by Dr.-Ing. E. Lackner), any tendency for the foundation of the structure to lift up from the subsoil is prevented for all conditions of loading. In addition, a more favourable distribution of the bending moments in the dock floor is achieved by an appropriate disposition of the prestressed anchorage cables. In all, 496 anchorages were employed.

The ship type caisson gate is a steel structure of 293.5 tons weight, fabricated by Dortmunder-Union-Brückenbau AG. It has a span of 31.4 m. and must resist a total water pressure of 1170 tons and transmit this force to the vertical side jambs of the dock entrance. The entrance sill has a flat surface (i.e. without a rabbet) and can therefore only take up vertical forces. The seal is affected by means of heavy oak sill beams (29 cm. x 28 cm.) fixed to the gate and provided with a protruding rubber sealing strip; they bear against a steel meeting-face concreted into the sill. Foundation bearing pressures are caused by part of the selfweight of the dock gate and by the outside water pressure at the vertical side meeting faces. The water ballast and buoyancy compartments and the mechanical equipment are installed approximately halfway up the height of the gate. It takes about 15 minutes to empty (i.e. raise) or to sink the caisson gate. The gate carries a 2 m. wide gangway permitting the passage of electric platform trucks.

The choice of flooding and emptying equipment for the dock was very carefully investigated. Model tests were carried out at the Hanover research establishment for civil and hydraulic engineering (Franzius Institute).

The dock is filled by means of a flooding culvert of 2.4 m. x 1.6 m. cross-section embodied in the pump-house as well as by two 800 mm. diameter sluices in the caisson gate; these sluices are fitted with jet deflectors. The intake end of the flooding culvert is closed by a cast-iron penstock which can be electrically or manually operated from the pump-house by a system of spindle rods. A removable coarse screen is fitted in front of the flooding culvert intake; in the event of repairs having to be done to the penstock, this screen is replaced by dam-boards. At mean outside water level it takes about 40 minutes to fill the dock when it contains a 38,000-ton vessel; if there is no vessel in the dock the filling time is about 60 minutes. Dewatering of the dock is effected by means of three "MAN" axial-flow pumps with an output of 2 $m.^3$/sec. When filled to mean water level and containing a 38,000-ton vessel, the dock can be dewatered in about 2 hours; if there is no vessel in it, dewatering takes about 2.6 hours.

The drainage pumps are two "MAN" axial-flow pumps, each capable of discharging 100 litres/sec. These pumps serve to remove residual water and any seepage or surface water from the dock. The pump-house furthermore contains two fire-fighting pumps of 60 litres/sec. output each and a small seepage pump for the pump chamber. The pump chamber itself is located below ground level and is enclosed in an "Opanol" plastic sealing screen.

The control cabin is situated above ground. It contains a large central switchdesk with all the switchgear and control devices for the pumps and capstans. It furthermore accommodates pneumatic indicators for the internal and external water levels and equipment for issuing instructions through a loudspeaker system during the docking of ships; an inter-communication system to the individual warping capstans is also provided. Over the whole length of the dock there are, in all, 7 electric capstans of 8 or 12 tons pulling power, together with 6 roller-type bollards, 16 welded twin bollards capable of taking a pull of 30 tons, and two 60-ton pull single bollards at the dock entrance.

New Drydock for Emden, Germany—continued

The keel-blocks, on which the vessels are supported, are 1.20 m. high and spaced 1.00 m. apart. In all, 200 such blocks are provided. Each consists of a reinforced concrete block 55 cm. in height surmounted by a pair of oak transverse wedges and an oak triple-wedge arrangement with a soft-wood cap. In the end bays (Nos. 1, 8 and 9) the keel blocks are designed for local loadings of 300 or 250 tons/m.; in the inner bays they are designed for 155 tons/m. The dock floor has been designed to allow the keel blocks to be arranged alternatively in two rows, so as to enable two smaller vessels to be docked or built side by side.

The bilge supports serve to steady the docked vessel laterally, a total of twelve pairs being provided over a length of 155 m. Each consists of a steel girder placed transversely to the centre-line of the dock. The bearing nearest the centre-line is hinged, whilst the external bearing can be raised by means of elevating screws, so that the girder, which has a timber capping beam, is pressed against the ship's skin and ensures lateral stability. The elevating screws are operated by hand winches through a combined chain and bevel-gear drive. This arrangement enables vessels having differently shaped bottoms to be docked in succession without necessitating any modifications to the bilge supports.

The dry-dock is enclosed between two heavy crane tracks. On the side adjacent to the slipway runs a 16-ton crane with a radius of 16 m. (or a 32 m. radius at a load of 7.5 tons) and a 25-ton crane of 20 m. radius (or 38 m. at a load of 10 tons). This crane track was partly renewed and was strengthened so as to allow the two cranes simultaneously to handle the same load. The new crane track on the opposite side of the dock carries a 25-ton crane with a radius of 26 m. (or 39 m. at a load of 12.5 tons). The two large cranes, when operating in conjunction, can lift 50 tons.

A duct embodied in the heads of the walls and encircling the whole dock accommodates the various services and supply lines, viz., pipes for compressed air, oxygen, drinking water, water for fire-fighting purposes, steam for heating and for use on board the docked vessels. In compliance with safety regulations, the acetylene pipeline is placed outside the duct. The latter furthermore contains all the electricity supply lines for the pumps, capstans, welding sets, distribution boxes for electrically operated tools, lighting, telephone system, etc. A total length of 16 km. of electric wiring was installed.

The dock floor and walls contain a variety of embedded fittings such as anchor rings, gratings, fender rails, pipe fixtures, etc. The dock facilities also include a new building which contains the transformer station and switchgear, together with garage and storage space, office accommodation, and sanitary installations for the use of ship's crews and dock personnel.

The dry-dock with its ancillary installations has been designed and equipped in accordance with the latest engineering principles and is therefore able to meet all requirements for the rapid execution of repairs and the construction of new vessels.

Fig. 7. View of separate cofferdams for construction of dock entrance and body of dock.

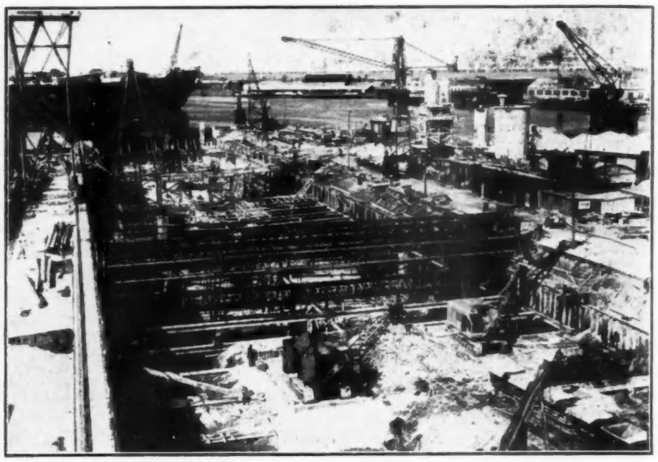


Fig. 8. General view of main cofferdam. The mixing plant is seen on the right. In the foreground the travelling gantry, 38 metres in length is visible. It carries the traversible tower from which the jetting and vibrating equipment for installing the anchor blocks is suspended.

The dock entrance and the body of the dock were constructed in two separate braced sheet-pile cofferdams. The excavation was kept dry by means of a dewatering installation.

In the first place, twenty wells were bored around the excavation. These wells were bored to a depth of about 20 m. in three stages, using casings of 1750, 1500 and 1250 mm. diameter respectively; along the existing crane track, however, space limitations necessitated the use of 1250, 1000 and 800 mm. diameter casings. The filters were 350 mm. (or, in the latter case, 300 mm.) in diameter. All the wells were equipped with submersible pumps. It was necessary to locate the dewatering wells outside the excavation so as not to disturb the filter gravel in the course of the subsequent vibratory treatment of the soil.

As the excavation was situated in a former bed of the River Ems, the soil conditions were not uniform over the site. The upper layer consisted of sea silt to an average depth of about 10 m.; underlying this was diluvial sand of varying grading. The underside of the foundation penetrates about 2 m. into the sand. Difficulties and consequent delays were caused by clay pockets which were encountered in the region of the dock entrance and which had to be removed with the aid of the vibroflotation process, with the addition of sand, so as to provide the structure with the necessary bearing on the underlying sand bed at these points. Further trouble was caused by heavily water-bearing strata which were encountered in the front third portion of the excavation and which occurred in conjunction with very fine sandy soil (running sand) which could be dewatered only with difficulty. Thus, twenty more wells had to be sunk within the cofferdam; these had to be provided with special filters and were subsequently concreted into the floor slab. In certain parts of the site small additional dewatering filters had to be installed; the inflow of water into the excavation was, moreover, reduced by means of a local cut-off formed along the sheet-pile wall by vibratory compaction. The flow of water into the individual wells varied a great deal; it fluctuated between about 7 and 25 litres per second and from well to well. Two standby diesel generating sets, of 180 and 100 K.V.A. respectively, were held in readiness for use in the event of failure of the electricity supply.

Excavation of the soil above ground water level was carried out while the outer row of dewatering wells was being installed. The earth-moving operations, inclusive of underwater excavation in front of the dock entrance and also including all ancillary structures, involved the shifting of some 130,000 m.^{3} of soil.

Excavation for the body of the dock was carried out by means of two grabs. The spoil was removed by Jubilee trucks (600 mm. gauge track) and conveyed to a distance of about 800 m., where

New Drydock for Emden, Germany—continued

Fig. 9. Anchor block slung between jet-equipped vibrators.

it was tipped as land fill. About 3 m. thickness of soil was first excavated so as to obtain a suitable formation level for driving the sheet-pile walls of the cofferdam. Two pile-driving machines followed close behind the excavators and drove the 12.75 m. and 13.75 m. long Larssen new type IV sheet piles (grade St 37 steel) in stages. A further 2.2 m. depth of soil was excavated, so that the bottom of the excavation was now at the level of the cofferdam bracing. The bracing was next installed and the remainder of the excavation, about 6.50 m. in depth, was thereupon executed, an approximately 30-40 cm. thick layer of sand being left as a surcharge at the bottom in view of the subsequent vibration and compaction of the soil.

The bracing comprised a waling consisting of a Peiner pile type 60 L, made of special sheet-piling steel, and cross-beams which each consisted of two sets of two Peiner piles type 40 L made of grade St 37 Steel. The latter, 17 m. in length, were welded together in pairs and the beams thus obtained were connected by a hinged joint over a row of vertical piles on the centre-line of the cofferdam. The bracing beams were placed 6.00 m. apart. This spacing was adopted so as to permit convenient excavation by means of grabs below bracing level and also to fit in with the spacing of the floor anchors, which are at 3.00 m. centres. All the walings and cross-beams were subsequently utilised for constructing the piled foundation for the new crane track beside the dock. For speeding up the work, the transverse sheet-pile wall at the end of the excavation was secured by means of horizontally driven round steel tie rods and an anchor wall.

In each case when the excavation of a section of the work had reached the requisite depth, the floor anchors were installed and the soil was uniformly compacted by additional vibration at various points. The anchor blocks were sunk to a depth of 11—14 m. below underside of foundation by means of the vibroflotation process (vibrator-jetting deep compaction). Two underground vibrators, connected by a cross-frame and provided with several water jets at their ends, accommodated in opposite recesses of the cruciform anchor block. During the process of sinking the anchor block the cross-frame transmitted the weight of the vibrators and jetting pipes to the block, which was lowered to its specified depth in a very short time by continuous vibration and jetting. The vibrators, which were kept running, were then slowly withdrawn from the ground, sand being added all the time. Good compaction of the soil above the anchor blocks was thus obtained. The vibrators together with their jetting pipes were suspended from a tower running on a travelling gantry. The gantry was 38 m. in length and spanned the full width of the cofferdam. Further compacted masses, or "cores," of soil were formed by the same procedure as that employed in installing the anchor blocks, so that very considerable firmness of the sand stratum under the foundation was in each case ensured.

This was followed by the operation of finishing the formation for the floor slab and placing an 8 cm. thick layer of preliminary concrete (blinding). The recesses of the sheet-piling were filled up with special purpose-made bricks; the surface was rendered and was provided with a bituminous coating which would permit sliding movement. The object of this coating was to preclude any possibility of the dock structure clinging to the sheet-piled walls in the event of vertical movement—otherwise undesirable stresses would develop in the floor slab of the dock and could have an unfavourable effect.

The reinforcement was laid on the concrete blinding, and the concrete was placed bay by bay. In all, 1,686 tons of reinforcement was installed, of which about 1,345 tons of grade St I steel was used in the construction of the dock itself. For the crane tracks grade St II and IIIa steel was used. The specified concrete strength for the dock body was 160 kg./cm.^{2} In order to achieve the desired density, a content of 300 kg. of cement and 30 kg. of trass per m.^{3} of finished concrete was specified. Before concreting was started, some very careful tests were made on the site with a view to determining a good mix for obtaining a pumpable and dense concrete. For improving the concrete and its workability an admixture (Vinsol-Resin) was employed. The "spread" of the concrete was 38 cm.*). The composition of the aggregates and the amounts of cement, trass and water were continually checked by a site laboratory. The concrete density and strength tests which were carried out at an official testing laboratory throughout the construction period confirmed that invariably a good, dense concrete was made and placed.

Inclusive of all ancillary works, a total of about 30,500 m.^{3} of concrete was used. An extensively mechanised mixing plant was established for the purpose.

The gravel aggregate was brought from the Rhine by barge. As supplied, this material already possessed the correct grading (German standard grading curve "E"), so that only some fine-grained material, necessary for improving the density and plasticity of the concrete and generally lacking in Rhine gravel, had to be added on the site. The gravel was unloaded by means of floating cranes, stockpiled and, when required, transferred by drag ships and conveyor belts to two preliminary bins where it was automatically batched to the correct quantity for any given mix and was then removed by means of belt conveyors and chutes to the hoppers of the individual concrete mixers.

The cement was supplied in bulk by rail in special wagons, of approximately 35 tons capacity, fitted with Polysius pneumatic discharging equipment whereby it was conveyed without any dust nuisance to a 200-ton storage bin. When needed, the cement was fed by Polysius discharging equipment to a Fuller-Kinyon pump which transferred it to a 15-ton elevated bin. Here the cement was weigh-batched and, like the gravel aggregate, was conveyed through covered chutes to the hoppers of the concrete mixers. Portland blast furnace cement was exclusively used.

* "Spread" (Ausbreitmass) is a German standard criterion for consistency of concrete and is a modification of the slump test. [Translator's note.]

Fig. 10. Anchor block being jetted into the ground.

New Drydock for Emden, Germany—continued

The trass was supplied, stored, weigh-batched and fed to the bins of the mixers in the same way as the cement. The overall composition of the mix was electrically controlled from a central point. The automatic batching of the mix ingredients ensured consistently good quality of the concrete made. In all, three 750-litre mixers and three concrete pumps were provided: two sets of equipment were normally in use, the third serving as standby capacity. The greatest distance to which concrete was pumped was about 170 m. With two sets of equipment in operation, the concrete plant had an hourly output of 25—28 $m.^3$ of finished concrete.

The sub-division of the concreting work into separate bays was determined by local and constructional requirements. The floor slab of the dock was first constructed, block by block, each block being concreted in three bays separated by 1.30 m. wide side gaps in order to permit equalisation of the shrinkage stresses. After shrinkage had taken place and the foundation anchorage cables had been tensioned, these gaps were plugged with concrete. The side walls of the dock were first concreted to just below bracing level After the concrete had hardened and the floor anchorages had been tensioned, the cofferdam bracing was dismantled and the walls were then constructed to their full height in two further lifts.

Travelling formwork, which was very economical in operation, was developed for the bottom portion of the side walls. The upper lifts were constructed with the aid of prefabricated formwork panels, each panel being shifted along from block to block by means of a crane. By using tongued-and-grooved boards for the panels, a neat, smooth concrete surface finish was obtained.

The dock entrance was constructed simultaneously with the body of the dock. The location of this part of the structure in direct proximity to the harbour basin necessitated special precautions. In the first place, 15.70 m. and 16.70 m. long Larssen new type III sheet piles were driven in stages, and an enclosed cofferdam (12.0 m. x 46.4 m. in size) was thus formed. Excavation was then carried out by means of a rail-mounted grab excavator travelling on a supporting framework on the harbour side of the cofferdam. The spoil was loaded into barges and dumped elsewhere in the harbour area. Following on the excavation work the bracing, of combined timber and steel construction, was installed at three different levels in the cofferdam. The bottom of the excavation was situated 12.20 m. below mean harbour water level.

After the concreted foundation slab had been placed and had hardened, the sheet-pile wall adjacent to the harbour was strutted with inclined timber shores of 38 cm. diameter bearing against the dock floor. The earth core which had been left standing in the dock chamber to serve as an abutment for the bracing of the dock entrance cofferdam was then removed and the inner sheet-piling burned off within the chamber. The earth core on the side adjacent to the harbour was removed by underwater excavation, and.

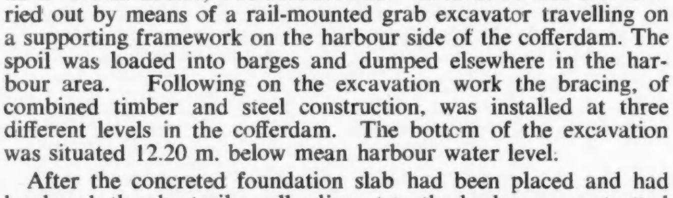


Fig. 11. Travelling formwork for bottom lift of wall and formwork panels for upper portion.

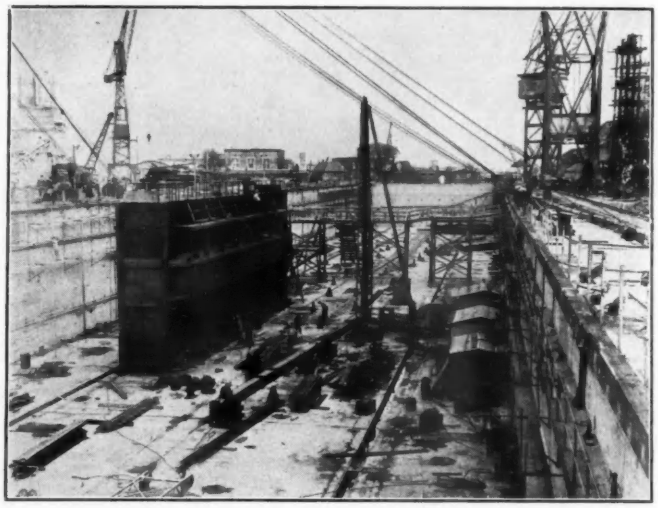


Fig. 12. View of dock shortly before completion, showing caisson gate assembled and ready to be floated into position.

after completion of all concreting operations and the installation of all pumps and sluice valves, the dock was flooded.

The sheet-pile wall on the harbour side of the entrance cofferdam was then burned off under water, the caisson gate—which had been assembled in the dock chamber—floated into position, the dock dewatered, and the rest of the work carried out.

The execution of the various ancillary structures proceeded simultaneously with that of the main work, e.g. the construction of the dock-operating building, the construction of a new crane track about 270 m. in length running along the dock, the partial renewal and strengthening of the crane track situated between the dock and the adjacent slipway, and the construction of a quay wall beside the pump-house.

The site work commenced in the middle of June, 1953. The dock was put into service on the 15th December, 1954. Thus the construction period was eighteen months,* inclusive of a delay of about three months due to severe frost and to the above-mentioned difficulties caused by the water-bearing strata encountered in the front third position of the dock body and by the clay pockets at the dock entrance.

Such rapid construction of this modern dry-dock and the high standard of workmanship achieved was made possible only by the ideal co-operation between the owners, the contractors, the supplier firms, and the designers of the civil engineering works and of the equipment of the dock.

Progress on Kilindini Berth.

The East African Railways and Harbours Administration have given details of the progress of the work at Kilindini. They announce that by the end of this year No. 10 Berth at the port will be ready for limited use, while the 120,000 sq. ft. transit shed, to be used with the berth, should be completed by the second half of 1958.

It is anticipated that the berth cylinders, which are being sunk in the sea bed to depths of over 100-ft. below L.W.O.S.T., will be in position by July or August next. It was originally planned for 226 cylinders to carry the berth, but, owing to the landslide in 1954, it was found necessary to increase the quantity to 240. The landslide caused the collapse of the first planted cylinders, and these have, in some instances, blocked the passage of the new piles. It has been possible to cut through many of the sunken cylinders, but in some cases new positions have had to be found. By the end of March, 180 new cylinders had been planted.

The manufacture, on the site, of pre-stressed post-tensioned decking beams, each weighing 20 tons, has been stepped up to four completed beams per day. Altogether 700 main decking beams are being manufactured, of which 195 had been made up to the end of March.

The River Tees

Its Present Facilities and Plans for Future Development

By J. S. B. GENTRY, C.I.E., O.B.E.

The Past.

MANY publications exist describing in detail the evolution of the Tees from a comparatively insignificant stream of 200 years ago to the modern industrial waterway of the present time. These documents describe the physical changes, both natural and man-made, as well as the various controlling and administrative arrangements, which have contributed to the development of a busy river we see to-day. It is not proposed therefore to dwell on the past, beyond recommending those interested but not informed about the early days to read about them in such publications as the Conservancy Commissioners' Centenary Book produced in 1952 or other accounts issued locally, such as the Middlesbrough Corporation Handbook, which from time to time contain articles based on script provided by the Tees Commissioners.

Present.

It is a matter of opinion as to where the past history of the Tees ended and the present began. The same problem presents itself in other fields, for example, in deciding which were the good old days or when was " in my time " as the old gentlemen say. In the case of the Tees, however, it is fairly obvious that the present era began in the period when the importation of iron ore in large quantities commenced, say about 1882. This may seem a long time ago when you think of the date but until recent years the basis of the trade through the Ports of the Tees was almost entirely the import of bulk ores and, to a lesser extent, the export of manufactured iron and steel. The difference in the quantities is interesting. In 1880 the annual import of iron ore was 303,000 tons, in 1900 it was 1,717,604 tons and in 1956 3,112,031 tons and it is estimated that in 1960 4,000,000 tons will be imported.

As it is the intention in this paper to place the emphasis on current and future conditions and requirements which involve the River Tees and in some respects other ports, it will be expedient in discussing the present to go only into details respecting the decade commencing in 1946. At about that time and perhaps a little earlier, it had already become apparent that there were several important new features which would affect to a marked degree the future activity and forward planning of the Tees-side industrial area generally and therefore its harmonising with the port and river in particular. The main factors, some of which are local and others general, may be listed as follows:—

1. Modernisation and expansion in the iron and steel industry, involving increased importations of raw materials and the necessity for further means to handle the ships engaged in the traffic.
2. Expansion on a large scale of the chemical industry, e.g. the purchase for immediate development of a 2,000 acre site at Wilton by Imperial Chemical Industries Limited.
3. Increase in the size of merchant vessels of all descriptions.
4. Increase in the importation and consumption of petroleum products of many varieties. This includes:—
   (a) Oil feedstock for cracking at I.C.I.'s Wilton factory.
   (b) Operation of steel furnaces by oil instead of coal.
   (c) Conversion of merchant shipping to oil instead of coal burning.
   (d) Increased use of oil as a domestic heating agent.
5. Expansion of the shipbuilding industry in respect of:—
   (a) Replacement of tonnage lost during the Second World War.
   (b) Construction of larger vessels.
   (c) Construction of oil tankers in increasing numbers.
6. Increase in the use of road transport, especially as a means of receiving imports and delivering exports.
7. Overcoming arrears of river maintenance and replacement of harbour craft, particularly dredgers and hoppers.
8. Provision of modern shipping facilities to cater for many of the requirements arising from the above considerations.

The primary concern of this article is to give an account of the responsibility of the Tees Conservancy Commissioners and how they have discharged and are still discharging it, but it must be mentioned that the three other industries to which reference has been made, i.e. iron and steel, chemical and shipbuilding, have expanded rapidly in the last ten years and there now stands on the south side of the river the extensive post-war factories and works of Imperial Chemical Industries at Wilton and Dorman Long & Co. Ltd., at Lackenby, both of which have not only been in production for several years but are still developing. Other iron and steel plants in the area, particularly Cargo Fleet and South Durham, are also developing and breaking into new fields such as the manufacture of pipes in huge quantities for export to the American continent, especially Canada. The shipbuilding firms of the Furness Shipbuilding Company at Haverton and Smith's Dock Company Limited at South Bank have launched many new ships, totalling hundreds of thousands of tons and both firms have extended their Yards, which are working to capacity.

To revert to the theme of the port, the Commissioners felt that they should assist in the expansion of the area by providing adequate reception and operating accommodation for the increased shipping of all descriptions and, equally important, by ensuring that there were proper facilities for the larger ships. The Commissioners therefore sought and obtained Parliamentary powers to build at Lackenby an open dock, two oil jetties, a dock road and railway, together with the related and subsidiary works. These powers included the very important statutory power to trade, i.e. to operate these installations when built. For reasons outside the Commissioners' control there was a long delay before work on the open dock could commence. This is now well in hand and when complete there will be a total length of quay of 3,000-ft. with a depth alongside of 32-ft. at L.W.O.S.T. The Commissioners own the land adjacent to the new dock and this is available for future extensions or other port developments. The two oil jetties and the road were completed by 1950 and have been in operation since that date. They are able to accommodate the largest tankers that can enter the river and have depths alongside them of 37-ft. and 34-ft. at L.W.O.S.T. respectively.

Immediately at the rear of and connected to the oil jetties are two tank compounds, the first, which has been in operation for over five years, is owned by Imperial Chemical Industries Limited and is linked by pipelines to their post-war Wilton factory and their large pre-war Billingham Works. The pipelines run in a tunnel under the river bed and are an integral part of the successful operation of these two industrial projects.

The other tank farm is owned and operated by Shell-Mex & B.P. Limited, who have installed nearly 150,000 tons of tankage with scope for at least double that capacity. The Company is primarily concerned with the distribution of oil to local industry. In addition there is available both at the jetties and by tanker barge all over the port an oil bunkering service, the demand for which is increasing.

It is estimated that during 1957 approximately 1,000,000 tons of oil will pass over the Commissioners' Oil Jetties at Teesport and that this figure will be exceeded within the next few years.

All the port developments outlined have cost the Commissioners to date nearly £2,000,000 but, in addition, they have also spent nearly £1,000,000 on improving their river fleet, the principal new units of which are:—

One suction hopper dredger of 1,350 tons capacity (sand).
One multi-bucket ladder dredger.
Three self-propelled hoppers (1,000 tons capacity).
One general purpose vessel for attending buoys, lights, sounding and towage.
Sundry small but essential units.

Much expenditure has also been incurred in the modernising of navigational aids in the approaches to and in the river itself. The

River Tees—continued

principal one is a radio direction finding beacon at the South Gare Breakwater at the entrance to the port.

In addition to the post-war developments of the leading industrialists and the Commissioners to which reference has been made, there have been simultaneously many other progressive features affecting the Tees, some of which are:—

(a) Improvements to the Middlesbrough Dock costing approximately £500,000.
(b) Modernisation and extension of Stockton Corporation Quay.
(c) Modernisation and increase in the number of fully equipped tugs owned by the Tees Towing Company.
(d) Setting up of Trading Estates under H.M. Government's policy of diversification of industry.
(e) Considerable increase in the responsibilities of Local Authorities, particularly those of the Redcar Corporation and the Eston Urban District Council, in whose area the greater part of the big developments have occurred.
(f) Construction of a new power station as an extension of the existing North Tees unit.
(g) Extensive use of slag (formerly a waste material) for construction purposes, including arrangements for the shipment of large quantities to South of England ports.

Slag Exports from the Tees

1928	...	...	52,000 tons
1931	...	...	107,000 tons
1956	...	...	185,000 tons

It was only to be expected, as is the customary experience with major developments and expanding economy, that a number of serious problems affecting all interests have been encountered which can only be solved by the close co-operation and goodwill of all concerned. The three most important and difficult of these which continue to engage close attention are:—

(a) Supply of manpower of all descriptions and at all levels.
(b) Supply of raw materials.
(c) Fresh water supply for industry.

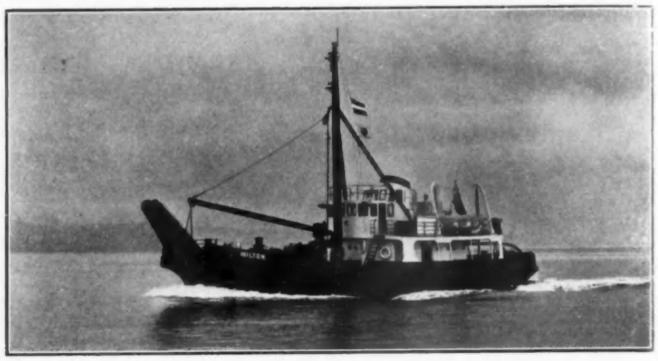
In the latter connection it is noteworthy that the weekly average demand for water on Tees-side in March, 1947, was 167,000,000 gallons per week. By January, 1957, this figure had risen to 210,000,000 gallons per week and it is estimated that by 1970 the demand will be in the region of 400,000,000 gallons per week.

The Tees Valley Water Board have been most active in grappling with the situation and have increased the supply by various new works and expedients. They are also engaged at the present time in the construction of a new reservoir at Selset and are exploring the possibilities of similar works at Dine Holm Scar. It should also be acknowledged that the industrial firms have assisted, both financially and physically. For example, Imperial Chemical Industries have built their own reservoir near to their Wilton Estate and have made other contributions towards the solution of the problem.

The supply of raw materials is largely a matter of nation-wide production and demand but not entirely, the necessity for Britain to export to the maximum has naturally had its effect.

Manpower both for construction and operating is, and appears likely to be, the biggest impeding if not conditioning factor to progress. There is no doubt that construction of new works, production in many local factories and also the number of ships built and launched would have been accelerated or increased had there been a greater supply of manpower available. It is thought that as the supply of houses increases some relief will be experienced in the labour shortage. It is also stated that the numbers leaving school per annum will greatly increase during the next few years. It may also be that men will be attracted to Tees-side through more comfortable conditions of working or as a result of lower demand in certain areas outside. These comments may be applied to craftsmen as well as to unskilled workers.

On the higher administrative and engineering levels most firms are short of an adequate complement and there is no doubt that one of the reasons for this is to be found in the demand abroad, particularly in several parts of the African continent for qualified technicians.



General Purpose Vessel "Wilton."

The Future.

The future of course has already commenced, both in the planning and physical sense. The evidence of this, so far as the Tees Commissioners are concerned, is the work on the open dock at Lackenby which has been proceeding now for over two years and which will take several more years to complete. Similarly in the field of local industry, especially the iron and steel and chemical trades, there is visual evidence of the preliminary stages of factories and works which will not be in operation for some years. Shipbuilding firms too have in some cases progressed beyond the planning stage of new facilities which are being introduced to take care of future requirements. The Central Electricity Authority have acquired a large area of land on the north side of the Seaton Channel for the construction of another power station. None of this activity is surprising or abnormal as no successful organisation of any importance could remain so, nor in fact survive for long without constantly reviewing its current operations simultaneously with legislating and providing for the future.

The port industry is no exception and, if only because of the length of time required to effect major improvements, such an undertaking must think further ahead than a specific trade deciding upon the extension of a particular production unit or the building of a new one. For example, take the building of a new dock with five modern berths such as the Tees Commissioners are pre-occupied with at the moment. In the first place, a port authority cannot build a dock even if it has the money or can raise it economically and the trade expectation warrants it. Statutory powers by means of a Bill in Parliament must first be obtained. Assuming that a suitable site is available, outline plans of some accuracy must be produced, followed by detailed working plans which lead up to the placing of contracts, most of which are in turn synchronised with other operations such as land reclamation and/or dredging. Naturally many of these steps take place simultaneously or overlap, but it can be taken that from the moment the responsible Board takes the vital decision to proceed with the project and assuming that no unforeseen delays occur, then the total period from the initial Board decision until the first ship enters the new dock would be not less than eight years under favourable conditions. Such conditions exist on the Tees, where no demolitions or clearance work was first involved, but ten or even more years would be required where the location of the dock is on a site which involves much time, labour and cost, in clearance work which strictly is not part of the dock scheme itself.

To sum up the position to date on the Tees, it can be said that two modern oil berths exist, preliminary work on the open dock project has commenced and that the two sites are already served by a first-class road. The care and maintenance of the river, which really comes first, has been provided for by the modernisation and expansion of the dredging and appliance fleet. All this has taken place in the quite short span of well under ten years, yet it can be broadly said already that although the two oil jetties have only been in operation for five years, they can be regarded in view of the development in the size of tankers, likely to be soon obsolescent. This factor will undoubtedly influence the future of many British rivers and ports including, it is almost certain, the River Tees.

River Tees—continued

For many years past the trend in the construction of ocean-going ships has been to build bigger ones and this has been markedly so since the end of the Second World War, especially as regards tankers. British ports have been closely involved and affected by this policy, which is due primarily to economic considerations and also to the fact that since the war several refineries have been constructed in the United Kingdom. The effect of bringing crude oil from overseas to Britain in large quantities has been two-fold:—

1. Deep water in the relevant port approaches and alongside refinery berths has been essential to cater for the big tankers engaged in the traffic, and
2. Adequate depth of water is necessary at ports possessing oil terminals, because the distribution from refinery points by sea to British ports is in the main carried out by the largest ocean-going tanker that can enter the port and discharge expeditiously and in safety.

It was for the above reasons that the Commissioners constructed their two oil jetties to what was regarded as unusually large dimensions at the time.

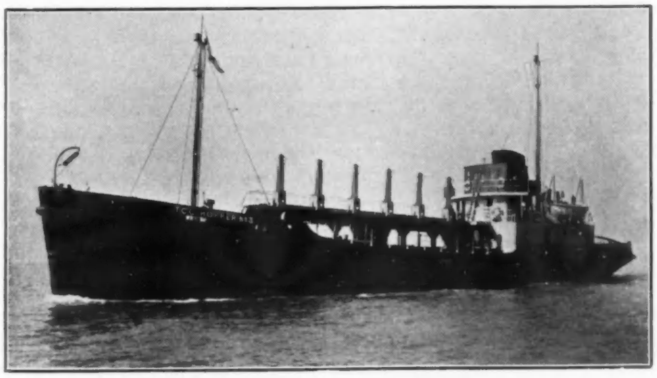
The upward trend in tanker building continues and on a world basis tankers of 32,000 D.W.C. are common, those of 45/65,000 D.W.C. are plentiful, while some 80/100,000 tonners have been built and there is serious talk in the trade of the numbers in this class being increased.

The political situation in the main oil producing area of the Middle East has undoubtedly accelerated planning in this direction and the result may well be the permanent policy of bringing more oil round the Cape route in the largest tankers practicable.

In these circumstances, an obvious consequence is a request to port authorities owning oil installations to provide or at least seriously to consider the provision of deeper approaches, deeper river channels and greater depths alongside their oil discharging berths.

The River Tees is fortunately well placed to play its part if the necessity arises in receiving and handling bigger tankers than those trading to the port at present. In the first place the foundations of the two oil jetties are capable of withstanding several more feet of water, which can be provided comparatively quickly and cheaply by dredging. Secondly, the characteristics of the Tees are such that it is almost certainly a practical proposition to deepen the approaches to the port and to deepen and widen the navigable channel, developments which will take time and incur heavy cost. The point to be remembered, however, is that some ports are incapable of being improved in these respects.

As has already been pointed out, the importation of ore of all descriptions is the largest import into the Tees and is anticipated to increase to 4,000,000 tons p.a. within the next few years. Here again the size of vessels engaged in the trade has already increased and it is certain that the larger vessels now operating will increase in the frequency of their arrival. Other large carriers are under construction and it is known that there are plans for increasing the dimensions of these ships still further. This may involve the Commissioners in river deepening operations and will naturally mean that suitable working berths will have to be provided by those responsible for the reception of the cargo. The largest ore carrier at present using the port is approximately 14,000 tons, drawing an average of 26/27-ft. The advent of the larger ore carrier has already involved the river authority in an ancillary problem in the provision of berths where these big ships can wait near to the discharging point. The explanation of this necessity is that ore arrives from many different parts of the world and is loaded and discharged at a very rapid rate—nearly 20,000 tons in 24 working hours is quite common. It is inevitable therefore that at times, particularly when certain loading ports, closed during the winter through weather conditions, re-open, "bunching" occurs at the discharging port. The Ironmasters naturally wish to get the next ship under their discharging equipment as soon as the previous one is cleared and therefore prefer to have the next ship on turn moved into the working berth in a matter of an hour or two. The Tees Commissioners have no statutory responsibility to provide waiting berths in this connection but, if only on account of the part they are expected to play in ship turn-round, they feel they have a moral responsibility to provide a reasonable amount of waiting accommodation—not only for ore ships who are the main users but also for other shipping which has to wait for various reasons.



No. 3 Hopper (1,000 tons capacity).

The future prosperity and development of the Tees will rest mainly, if not entirely, on the future of the iron and steel trade, the oil industry and the provision and successful operation of the Commissioners' new Lackenby Dock, probably in that order, but it would not be surprising if in due course the oil business approaches the present importance of that of iron and steel. The reason for this somewhat prophetic suggestion is that the Tees is well situated geographically and has the area available for the construction of an oil refinery or for an additional large oil distribution depot. The site for this would be on the north bank on land already reclaimed, plus adjacent areas which could be reclaimed comparatively quickly.

As regards the deepwater berths for general shipping, in view of the increased size of merchant ships and the insurmountable physical limitations of certain existing installations, it appears that there need be no apprehensions about the ultimate success of the Lackenby Dock scheme.

The Seaton Channel, which is an offshoot of the River Tees near to the entrance and within the Commissioners' jurisdiction has a great potential for industrial development and this is likely to commence in the reasonably near future. A site has already been acquired for a power station and the shipyard of Messrs. William Gray & Co. Ltd., may well be extended. Other industries are located on adjacent land, of which there is ample available for future requirements.

RIVER TEES IMPROVEMENTS

So much then for the principal developments of the immediate future. Now it must not be forgotten amid all these stimulating and important events that the River Tees itself is the primary consideration. Its capacity and efficiency in relationship to the movement of shipping traffic of all descriptions, from motor launches and tugs to large ore carriers and even larger tankers is fundamental to the satisfactory working of port installations, the prosperity of local industry and the welfare of all the inhabitants of Tees-side.

It is true to say that the improvement of the river and its satisfactory maintenance over the last hundred years has been a first essential of the growth of local industry. Irrespective, therefore, of any of the future developments which may come to pass, the river must be properly maintained and this of course is the Tees Conservancy Commissioners' statutory and first obligation to all.

At the present time there is a dredged depth at the entrance of the river of 26-ft. below L.W.O.S.T., with a rise of 17-ft. and 12-ft. on Spring Tides and Neap Tides respectively. The latter feature will of course remain constant but the dredged depth can be improved. Any scheme of this nature however must take account of conditions outside the river entrance where there is a length approximately 4,000-ft. known locally as the Middle Ground where the minimum depth is 25-ft. below L.W.O.S.T. It will readily be seen, therefore, that very little deepening beyond the present depths would be of any value without there first being an improved entrance channel cut through the Middle Ground. It is not too much to say that the Middle Ground situation conditions to a large extent the size of vessel, at least as regards draught, that can

River Tees—*continued*

enter the port. It is known that a channel can be cut through this area and that the navigable channel inside can be improved. A first stage could be to increase the depth over the Middle Ground by 9-ft. to 34-ft. below L.W.O.S.T., followed by dredging in the main river channel to a depth of 30-ft. at the entrance graded to 26-ft. at, say, a point opposite Cargo Fleet. These works will inevitably involve subsidiary ones such as modification of certain existing navigational aids, constructing a new training wall on the north side of the estuary, and, if bigger tankers and other ships are to be fully provided for, provision of a turning circle, say 1,000-ft. in diameter and also waiting berths dredged to 40-ft. below L.W.O.S.T. for big ships.

Further works which it might be considered desirable to include at this stage would be the graded deepening of the river from Cargo Fleet to, say, Haverton Hill, provision of more satisfactory accommodation for the Commissioners' self-propelled craft during non-working hours and also, possibly, additional waiting berths.

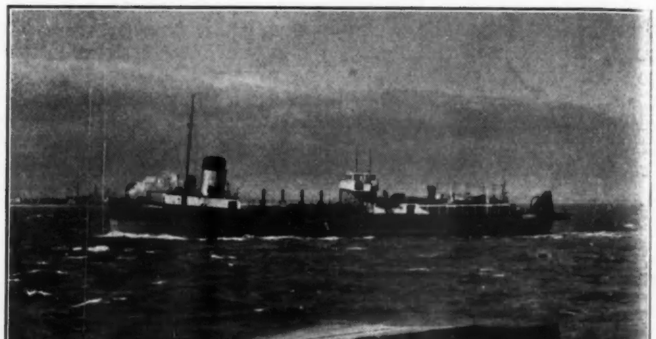
To provide this accommodation for vessels drawing up to 34-ft. would take about 5/6 years to carry out.

The second stage, which on account of the time involved alone must be a long way ahead, would be to provide accommodation for vessels drawing up to 40-ft., which would mean that the channel through the Middle Ground would have to be 40-ft. below L.W.O.S.T. or 15-ft. deeper than at present. The corresponding depths in the river would be 35-ft. at the entrance rising to 26-ft. at Cargo Fleet. It would also be necessary under this scheme to alter the existing training walls and construct new ones as it would envisage the widening of the channel to 1,400-ft. at the Fairway Buoy, 800-ft. at Teesport and 500-ft. at Cargo Fleet

If Stage 2 immediately followed the completion of Stage 1, the whole of the programme would occupy approximately ten years.

It will be realised from the description of the different river developments that have taken place and which are likely to continue, that an increasing commitment for maintenance falls upon the Commissioners. This has already necessitated the acquisition of additional craft and further units will be needed as the years go by. The question therefore arises as to what type of dredging equipment will be the best from a practical and economic point of view. Now the story of the Tees is one of continued seaward development in search of deeper water and the nearer to the sea the greater the proportion of sand there is to be found in the river bed. There is also the question of dredging busy ship berths which should not be placed out of commission for long periods at a time. It would seem therefore that on both these considerations the multi-bucket ladder dredger will not be the best type of equipment for down-river operation and still less for work in certain confined areas. In the first place much time is required to fix this type of dredger in position and a good deal of space around her is somewhat immobilised by her mooring cables. It is also necessary to attend on this type of craft with hoppers, which take up space and reduce flexibility. It is visualised therefore that some other type of dredger will take care of the future maintenance work in the two respects mentioned. There are two leading types which would be suitable, viz. a suction unit or a multi-grab one. In both cases the hopper should be embodied in the dredging craft so that the dredger can take advantage of short periods when a ship berth is available and return after perhaps leaving the job for a few days while a ship is accommodated. The dredger could be usefully employed elsewhere in the meantime. The presence of sand in the lower reaches means that a suction dredger could be employed in the most suitable kind of material for this method of dredging. It is not suggested that a suction dredger is entirely suitable for ship berths but what does seem to be clear is that the bucket ladder type will not meet the requirement.

With regard to the future of the oil traffic in the matter of discharging and/or loading facilities, it is not anticipated that additional jetties will be necessary as there should be ample capacity at the existing ones at Teesport for all forecasted requirements for ten years at least. It might be, however, that one or other of the oil interests may construct its own jetty on a frontage that the Tees Commissioners could provide on the north side to serve another large distribution depot. Before leaving the future of the oil business it can be mentioned that the loading or discharge of oil from



Suction Hopper Dredger of 1,350 tons capacity).

tankers does not inevitably involve the provision of a jetty or wharf for the tanker to berth alongside. In certain areas it is quite practicable to pass oil to and from the tanker by means of floating pipeline but this scheme obviously depends on the conditions obtaining in each particular area.

A feature entirely absent on the Tees at present but used intensively in certain other ports is a lighterage service. The volume of suitable traffic for this means of transport has to be available to make its provision a sound proposition. This does not exist on the Tees at the moment but the demand could well arise in the future. The river would not be difficult for the navigation of lighters and there are one or two points, notably Stockton Corporation Quay, which lend themselves to the easy discharge and loading of such small craft. Transport by lighter of the right type of cargo is comparatively cheap when all costs considerations are assessed.

Another facility which will quite certainly be required in the years to come is an additional or more modern crossing of the river, particularly as the port development area is creeping gradually nearer to the sea and away from existing crossings. There is no crossing of the river at all at present below the Transporter Bridge, which has served a useful purpose up to now but has limitations for heavy and voluminous traffic.

A future crossing of the Tees would probably be well below the site of the Transporter Bridge and may be by bridge or by tunnel—almost certainly the latter.

In 1949, arising out of the issue by the Regional Planning Authorities of a future development plan for the area a special committee investigated the question of a further crossing of the River Tees, both as regards its nature and location. The recommendations of the Committee were broadly that from the point of view of initial cost and subsequent maintenance, any new crossing of the river should take the form of a high level bridge. The Committee said that a tunnel could only be justified if the demands of the navigational authorities, who advocated a tunnel, could not be met by a bridge and if the objections made to sterilisation of future development on the south bank which the bridge project would involve were upheld. It was recommended that there were only three possible locations for the new crossing; the furthest upriver being about half a mile upstream from Smith's Dock shipbuilding yard and the lowest at Lackenby. Generally speaking there were no physical difficulties to be overcome in the approaches of the crossing on the north bank but there would obviously be many on the south side. At the time of the Report, which was dated November 1949, the estimated initial costs were £3½ m. and £6½ m. for the high level bridge and tunnel respectively.

This paper does not cover all the present services essential to the operation of the river and port nor their possible future development. Such important contributions as those provided by the Pilotage Authority, Health Service, H.M. Customs and Excise, supply of fresh water, fire fighting, stevedoring and several others, including communications, are well known to all and must expand or be improved as the demand arises. Linking them all by different means are communications. In a business such as port and river management and operation there is constant movement

River Tees—continued

of ships, multifarious types of river craft, railways and road transport. The intelligent co-ordination of all this movement is achieved by different forms of communication, from sound and visual signals to the use of radar and radio telephone. The advent of radio telephone into the ambit of port communications has effected tremendous improvement and efficiency and on the Tees the introduction of this system to assist in the movement even of tugs, hoppers and other small craft, has proved of marked benefit as has the provision of means of communication between harbour craft and ships.

General.

Another activity in some ports that may well extend and develop in the future is the reclamation of land in conjunction with dredging operations, i.e. the pumping ashore behind retaining embankments of suitable spoil removed in the course of maintenance or capital dredging operations which would have been otherwise deposited in deep water, frequently at sea many miles away from the port approaches. This type of activity is not new where lowlying land or tidal foreshore is available within easy reach of the river, and its main advantages are two-fold in that land assets are created and overall dredging costs reduced. With the enormous rise in the initial cost of units of a dredging fleet—a bucket ladder dredger now costs approximately £250,000 or about four times its pre-war figure—plus heavy increases in the cost of operation, which includes wages, fuel, stores and maintenance, it is clear that the maximum use must be obtained from dredgers, hoppers and tugs during the hours they are at work. With the shorter haul of dredged material in hoppers to the point where their contents can be pumped ashore on the area for reclamation the cost of disposal will be lower by comparison and in the long term fewer carrying craft should be required. In ports where reclamation operations are practicable but do not take place at present, considerable capital expenditure is likely to be involved in the provision of pumping plant, the construction of retaining embankments and the acquisition of suitable craft (mainly dumb barges) for carrying the spoil. The conditions and requirements will vary according to the physical characteristics of the port. Even where land reclamation by this means has been the practice, additional capital cost may arise from time to time as areas reach the required level of reclamation and it is necessary to move the scene of the operations to another point.

Apart from the economics of the scheme which are a matter of calculation, it is suggested that where it is possible to create land by this means, serious consideration should be given to doing so. There would appear to be no likely end to port development, not only for the provision of shipping facilities, but also for industries which need to be sited adjacent to a waterway. The presence of a prosperous industry in the precincts of a port can only be to the advantage of the latter. It is worthy of note that the Tees Conservancy Commission have, for many years past, engaged in extensive reclamation work of this nature.

Tanker at the Commissioners' "Queen Elizabeth II Jetty."

Dock and harbour authorities, though the principal, are not the only providers of basic shipping facilities involved in the developments surrounding the transport and use of oil. Shipbuilders and dry dock owners must, if they are prudent and can compete, lay down properly equipped yards and graving docks to construct and later to repair the bigger tankers. Easily said, but not so easily achieved from an engineering point of view alone, quite apart from the very considerable financial aspect. It should be remembered that the provision of a large graving dock is not something that can be brought into being in a matter of months, nor in some cases in a year or two, nor can such an installation pay for itself at as rapid a rate as large projects in other industries. Also, if a graving dock becomes obsolescent it may not be possible, or only with heavy capital expenditure, to enlarge it and almost certainly not to enlarge it quickly. It is furthermore the fact that many shipbuilding and ship repairing firms in the United Kingdom, and doubtless in other countries too, have in the post-war years undertaken major developments to their yards. Some of these are not yet completed but have reached a stage of construction where it will be difficult if not impracticable to increase their dimensions. So it will be seen that the sudden increase in the size of oil tankers is a real headache to this extremely vital part of the shipping and docks industry as a whole.

A conditioning factor in the forward planning of a port or river authority must be the size of vessels of all descriptions likely to need accommodation. The basic requirement in this field is naturally the depth of water allied with appropriate width of navigable channel. It would seem at the present time that the building and operating of bigger ships may be confined to oil tankers, although in the iron and steel ports the authorities are being faced with the problems involved with the larger ore carriers engaged in that traffic. Larger tankers, however, are leading the field and although firm decisions may not yet have been taken by the world oil interests concerned, one or two concrete pieces of evidence are available from which it is reasonably safe to draw the conclusion that those ports whose physical characteristics make it a practical proposition to provide deeper and wider approaches and navigable channels would be wise to examine the relevant problems, to prepare plans against the almost certain demand and be ready to implement those plans when all the considerations involved have been crystallized. The evidence referred to can be found in the continuing policy to transport crude oil in large quantities for refining in the United Kingdom, which in turn dictates the largest practicable and economic oil tanker plus the fact that the supply of oil from the producing areas to the consuming points, cannot be permitted to depend in any important degree upon the availability of the Suez Canal. In any case, were there no political or international atmosphere surrounding the Suez Canal it should be borne in mind that its maximum depth is 40-ft., permitting a maximum draught, under favourable conditions of 35-ft. This may be quite inadequate for the passage of the economic tanker unit of the future. If this proves to be the case and there is reluctance for any reason to improve this waterway, other alternatives to the long sea route in the monster tanker are probably practicable, e.g. additional pipelines from certain oil fields to loading points where larger vessels can be accommodated. The fundamental and inescapable fact is that the demand for petroleum products, predominantly for all energy generating purposes, has increased sharply in the post-war years and must continue so to do until the harnessing of atomic power for industrial and domestic requirements becomes universal and economic. On this basis the repercussion on rivers and ports that has been described is complementary.

Quite clearly, therefore, it can be concluded that given a continuance of normal conditions the future of the river and the ports of the Tees is bright. The main industries associated with the port are basically of a national character and are still expanding, as is the port itself. There is scope physically for further development by means of deeper water, a wider channel, improved shipping facilities and additional projects in the principal industries as well as space for the introduction of new ones, while permeating the whole atmosphere is the essential enthusiasm of all those engaged daily in the many and varied activities.

Book Review

"Fires in Cargo Ships"

Ladsirlac Information Publication No. 1 on "Fires in Cargo Ships" by A. M. Bennett, M.I.N.A., M.I.Mech.E., M.I.Mar.E., has been issued by the Liverpool Public Libraries. Ladsirlac (Liverpool and District Scientific, Industrial and Research Library Advisory Council) is directed by an imposing list of public figures reading like a page from "Who's Who." The President is Sir Alan Tod, C.B.E., T.D., Deputy Lieutenant of Lancashire and Chairman, Liner Holdings Ltd., the Vice-Presidents being The Rt. Hon. The Viscount Leverhulme, Lord Lieutenant of Cheshire and Sir Ben Lockspeiser, K.C.B., F.R.S., M.I.Mech.E.

The publication reports a technical information lecture delivered at the Liverpool Central Libraries on 10th October, 1956.

Fire prevention can be likened to the work of the Local Authority Public Health Departments, it is only by constant surveillance that epidemics are controlled. The need for regular reminders of the dangers of fires in ships cannot be overstressed and with this in mind, the Liverpool Public Libraries are to be congratulated on their public spirited action in printing this booklet.

The author introduces the subject by comparing the fire risk in the wooden walled ships of yesterday with the steel giants of to-day. Whilst there is no doubt that fires once started in these old ships were extremely difficult to fight owing to the restricted area and the very inefficient fire pumps available, it is pointed out that even to-day serious fire hazards exist on board ship particularly on passenger vessels.

It is perhaps a little unfortunate that the author fails to mention the need for the closest co-operation between the Local Authority Fire Brigade and those concerned with managing the ship when in port. A ship is a complex structure and it seems to be in everybody's interest that the men who would have the final responsibility for extinguishing the fire should be conversant with the layout of the vessel. Every fire brigade has a trained staff of Fire Prevention Officers who are freely available to give advice, when asked, on all matters pertaining to fire prevention.

The danger of fire spreading throughout the length of the vessel in an "open shelterdeck" ship is very clearly dealt with in the booklet. Ship owners and naval architects might do well to ponder on the risk associated with this type of construction, which presents the risk of a total loss from fire of a size which would be fairly easily controlled in a full scantling ship.

Reference is made to the use of high pressure fog for fire fighting which has been developed in America. The latest information on this medium is that by and large the British Fire Service backed by the scientists at the Department of Scientific and Industrial Research, have decided that high pressure fog has no advantages over low pressure fog and that the high cost of providing special pumps cannot be justified. It is interesting to note that in America, too, the trend is again back to low pressure fog.

Quite a large section of the booklet deals with the new Inert Gas Producers which has recently been installed on some of the Elder Dempster Line ships. This makes most interesting reading, particularly the graphs dealing with practical tests carried out on the M.V. "Oti." There seems little doubt that this type of protection will be replacing the conventional high pressure Carbon Dioxide stored in steel bottles, with its associated danger of lack of continuity of supply which the writer forcibly points out can endanger the life of a vessel.

Summing up, this is a well written booklet which should prove to be of great interest to ship owners and those connected with the industry. It takes an important step forward to the day when the fire protection on British ships is as good as the sailor deserves.

The April issue of the Fire Protection Bulletin gives an account of the Ministry of Transport's requirements for the construction of passenger ship's bulkheads, stairways and other features and for the provision of fire-fighting equipment. Some of the more common causes of ship fires and their prevention are also described. There are special sections on ships in port and under repair. Copies of the Bulletin may be obtained, free of charge, from the Fire Protection Association, 15 Queen Street, London, E.C.4.

FOR SALE

4,000 lb., 9-ft. LIFT DIESEL COVENTRY CLIMAX FORK-LIFT TRUCK; 5,000 lb. 12-ft. lift Diesel Coventry Climax Fork-lift Truck; Ross Petrol driven Fork-lift Truck; 28 cwt. Conveyancer Petrol, 9-ft. lift; 1,500 lb. Coventry Climax Petrol driven Fork-lift Truck. All Coventry Climax's on pneumatics. B.G.PLANT (SALES AGENCY) LTD., Watlington, Oxfordshire. Tel. Watlington 44.

PORT OF BRISTOL AUTHORITY
SELF-PROPELLED "AIRVEYOR"

The Port of Bristol Authority has for disposal One Self-Propelled "Airveyor" portable pneumatic grain elevator, by the Fuller Company, U.S.A. The plant comprises a Rootes blower of 20-40 tons per hour capacity, driven by a 115 h.p. "Caterpillar" Diesel engine and mounted on pneumatic tyres as a trailer unit coupled to a General Motors' towing unit powered by a 6 cyl. G.M. petrol engine, together with a quantity of 8-in. steel and flexible piping. Applications for forms of tender to be made to the Engineer-in-Chief, Port of Bristol Authority, Avonmouth Docks, not later than 7th June, 1957.

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NIGERIAN PORTS AUTHORITY has vacancies for TRAFFIC OFFICERS/INSTRUCTORS. Men of matured experience aged 45 or above or with at least twenty years' practical experience in quay/shed work in a large scale port organisation.

Applicants must be of a keen and energetic disposition and have a requisite capacity and temperament for training Nigerian staff. Knowledge of all aspects of cargo handling essential including some years practical and supervisory experience in shed/quay work, customs and other documentary procedures and the use of mechanical handling equipment.

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BELFAST HARBOUR COMMISSIONERS

The Belfast Harbour Commissioners invite applications for the position of Harbour Master and Pilotage Superintendent for the Port of Belfast. Minimum commencing salary—£1,850 per annum.

Applicants must not be more than 45 years of age and must possess a Foreign-Going Master's Certificate of Competency.

Applications must be made on official forms only and forwarded to the undersigned together with copies of not more than three recent testimonials, not later than the 31st JULY, 1957.

Application forms may be obtained from the undersigned and no application will be considered unless made on the official form.

Canvassing in any form, either direct or indirect, will be a disqualification.

Harbour Office, F. W. P. HAMPTON,
BELFAST. General Manager and Secretary.